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# AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE AMERICAN MACHINIST PRESS,

Vol. 22. 218 WILLIAM STREET, NEW YORK. No. 30.

Contents and Index to Advertisers, Page 12.

In time of Peace prepare for war. In prosperity prepare for dull times.

What does your labor cost per year? What is your output?

Remember that the implements in the hands of your workmen determine the relation between the cost of labor to amount of output.

Whether in war or manufacturing, the best implements are essential to success.

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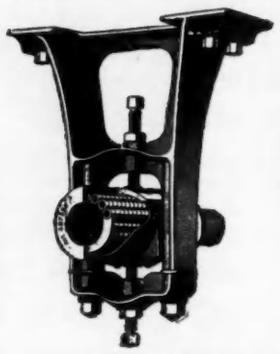

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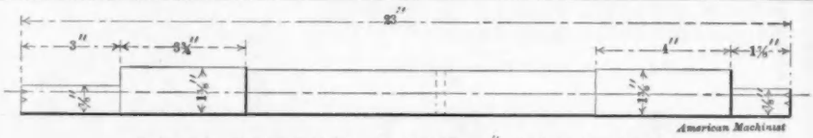


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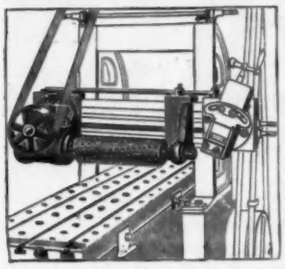
## MILLING MACHINE



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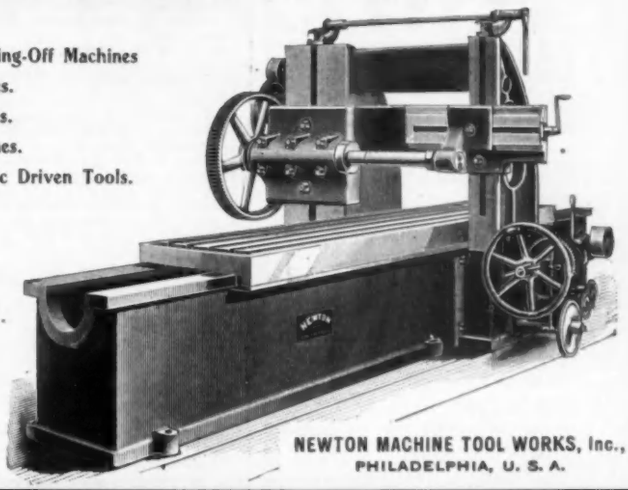

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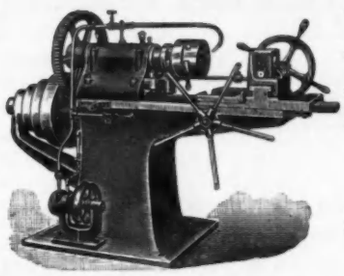

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# AMERICAN MACHINIST

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FRED J. MILLER, Chief.

FRANK RICHARDS,
F. A. HALSEY,
EDWARD P. BUFFET, } Associate Editors.

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## Department Stores.

We have previously expressed the opinion that department stores are not monopolies; that they can succeed only by selling goods at prices favorable to purchasers, and can do this only by effecting economies in the conduct of their business impossible with smaller concerns. It seems to us that Dr. Miquel, Secretary of the Prussian Treasury, spoke words of common sense when, in discussing a proposition to lay burdensome taxes upon such stores in Germany, he said:

"I personally am of the opinion that existing conditions in the different communities are so various, their relations to the great business houses so different, that the only safe method is to let them decide for themselves what is the best to be done. It would be extremely difficult to make a general government law for large and small cities alike, since the development of business varies radically in different countries and districts. One thing is certain, social and political justice could only be approximately reached by taxation; no tax can cover and fit exactly every socio-political condition. Exaggeration in this direction, the attempt to change economical conditions and commercial relations by taxation alone, might lead to dangerous consequences. The whole road is beset with dangers and difficulties that can be only dimly foreseen. If the smaller merchant is protected against the overshadowing department store, the mechanic might with equal justice demand protection from the great industrial factories. The blacksmith might say, 'I demand protection from the great forges and factories that manufacture wrought-iron products so cheaply that I cannot exist.' The shoemaker would demand a high tax upon the shoe factory that turns out shoes by machinery—and so it would go. Where should we draw the line?"

In other words, the speaker showed that the principle proposed would, if applied to industrial matters, effectually prevent the cheapening of products that has been going on for years, and throw us back into the condition of manufacturing that prevailed a hundred or more years ago.

---

The League for Social Service has been invited to co-operate with the United States Commission in preparing the exhibit of Social Economy for the Paris Exposition. The secretary for the league, Dr. Wm. H. Tolman, 105 East Twenty-second street, New York, would like to receive information regarding what is being done by any employer of labor anywhere in the United States to improve the condition of working people—that is to say, making any effort to do more than to simply employ men at the ruling rate of wages, under conditions that will barely enable him to retain the services of the kind of men needed to carry on the work. Any of our readers who may know of a shop or industrial establishment of any kind in which something out of the usual order is done for the benefit of employees, will perhaps contribute to the more general adoption of such practices by communicating with Dr. Tolman, as above.

---

Our esteemed contemporary, the "Electrical World and Engineer," in its issue of July 8, adopts a new way of writing United States money values, which should be promptly sat down upon. It writes the point after the cents instead of after the dollars, and follows it with the word cents or its abbreviation. Thus, $364.83 cts., which is given as the cost per day of one wagon, one horse and attendance, means really $3.6483. The misplacement of the decimal point, if adopted, must inevitably lead to confusion, and is entirely useless and unnecessary in any case that can arise, as after the two places which belong to the cents the fractions follow and are understood without any explanation. Our British friends might perhaps be excused for adopting the reprehensible practice here referred to, but it is hard to find any excuse for an American who does it.

---

## The Cost of Liquid Air.

BY FRANK RICHARDS.

Now that liquid air is easily procurable, at least in New York City and vicinity, by anyone who wants to dabble in it, and at a cost which is not prohibitory, the enticement to speculate as to its possibilities, and to practically experiment in its use, is an unusually strong one, and not without promise of profit.

In the present state of our knowledge, and with our present resources of skill, we must, of course, abandon from the beginning all expectation of being able to realize from the liquid air anything like the power that is employed to produce it; but, having thus given up whatever hopes we may have entertained in that direction, we immediately begin to discover conditions which strongly favor its adoption for certain purposes. The bugbear of power cost is worked for more than it is worth in many engineering fields, and especially so throughout the entire range of compressed air service. Power is really one of the cheapest instead of the dearest things with which we have to do; although it must be carefully considered in many undertakings. The story of the employment of compressed air, now so extensive, is nowhere one of high economy in the use of the original power, and in some of the most extensive and established applications of compressed air the losses, or, if you choose, the wastes, of power are enormous. But these very places, as, for instance, the air-brake service, and rock-drill mining, are the places where the alert readiness of the air renders it, after all, a most valuable and indispensable servant.

It will be interesting to note first what is the bottom cost of liquid air according to our present information. It is unnecessary, and it would, indeed, be foolish and unprofitable to attempt any minute accuracy in our estimate until the data upon which it may be based are close and reliable, as they certainly are not at present.

We can, however, form a tolerably correct idea of what liquid air can be produced for, and at what price it will, before very long, be possible for the prospective user of liquid air to buy it.

In the "American Machinist," June 15, we have a little account of the interesting air liquefying plant, in New York, of the General Liquid Air & Refrigerating Company. In the presence of this admirable installation Mr. Tripler's occupation as a producer of liquid air seems to be gone entirely. Here is a plant which, working at about 200 horse-power, will produce a gallon of liquid air per minute. In this simple statement is contained all that is necessary to enable us to approximately estimate (no guesswork about it) the cost of the liquid produced. It is a question of the cost of the horse-power used, and nothing beyond that, any more than there is anything else to be considered in the working of a pumping engine, or of the engines that drive a ship through the seas. There are practically no materials to be provided but the fuel, and the only labor is of the engineer and fireman class, with the necessary supervision.

The cost of power as developed by the steam engine varies widely according to the style of engine employed, and in a lesser degree it is affected by the local rates of fuel and labor and other conditions. The costs per horse-power hour have been computed and tabulated for all the various conditions, so that it is not at all necessary to compute them. In a table by the late Dr. Chas. E. Emery, which was published in the "American Machinist" April 1, 1897, the total cost of a horse-power hour (covering coal, labor, supplies and repairs, sinking fund, taxes and insurance, with 5 per cent. added to total and interest at 10 per cent.) is given as ranging from $0.0254 for an ordinary non-condensing engine to $0.00919 for a compound condensing engine, and $0.00811 for a triple compound. If liquid air ever becomes a staple commodity, and one of the necessities of modern life, which is not impossible, it may safely be assumed that then engines approaching the highest economies will be employed in its production. For our present purposes I am disposed to assume $0.015 as the cost per horse-power hour, which is somewhat higher than the rate given in the table referred to ($0.0143) for an automatic cut-off, non-condensing engine.

In the plant we are considering, 200 horse-power produces 1 gallon of liquid air per minute. As a gallon of liquid air weighs (nearly enough for our purpose) 8 pounds, the 200 horse-power in one hour, or 200 horse-power hours, would produce $60 \times 8 = 480$ pounds of liquid air; so that 1 pound of the liquid would cost $200 \div 480 = .416$ horse-power hour. Professor Morton, by the way, computes the cost of liquid air as produced by Mr. Tripler at 10 horse-power hours per gallon, or 1.25 horse-power hour per pound, which is almost exactly three times as great as our .416 given above. As our cost per horse-power hour is $0.015, the cost of 1 pound of liquid air will be $.015 \times .416 = .0062$, and $.0062 \times 8 = .0496$—say 5 cents per gallon. This may be taken, I think, as a fair estimate of the cost of liquid air at the works. Milk retails in New York as low as 3 cents per quart, or 12 cents per gallon, so that we may some day see liquid air selling as low as cheap milk, although it may still be some time before it is as commonly used.

Having the liquid air thus begging to be employed, the next thing to promote its use is the facility with which it may be transported. No franchises and no favors are required from any municipal authorities. There need be in its interest neither pipe-laying nor wire-pulling. Any truckman may carry the liquid anywhere. Stores of it may be established at different points, so that anyone could replenish his supply without going far. Supposing vehicles to carry liquid air for propulsion, no time would be lost in recharging.

I am not here advocating the use of liquid air for vehicle propulsion, or for any other purpose, but simply trying to get an idea of the prospective cost of the liquid for anyone who may propose to use it. It is not likely that, for a considerable time at least, the air will generally be procurable "at cost," as I have here figured it; so that if anyone is thinking of using it, say for automobile work, he must put his figures much higher than mine as here given. And then the constant loss of the liquid by evaporation, the leakage over the top of the vessel which contains it, must never be lost sight of. There is no way in sight of storing liquid air tight and safe; so that practically it must be used nearly as it is produced. It will not keep over night. The loss may be kept quite low with suitable insulation, and the larger the quantity stored, the smaller the proportionate loss; but still the pull will be unremitting, and all in one direction.

## Assistant Ship Draftsman, Navy Department.

The United States Civil Service Commission announces that on October 3, 4, 5, 1899, examination will be held at any city in the United States where it has a board of examiners, for the position of assistant ship draftsman qualified in designing electrical machinery of war vessels in the service of the Navy Department. The minimum age limitation for entrance to this examination is twenty years, no maximum.

From the eligibles resulting from this examination, certification will be made to fill the position of assistant ship draftsman qualified in designing electrical machinery of war vessels, in the Navy Department service at Newport News (Virginia) Navy Yard. This examination is open to all citizens of the United States who comply with the requirements. All such citizens are invited to apply. They will be examined, graded and certified, with entire impartiality, and wholly without regard to any consideration, save their ability as shown by the grade attained by them in the examination. Persons desiring to compete should at once apply to the United States Civil Service Commission, Washington, D. C., for application blanks (Forms 304 and 375), which should be properly executed and promptly filed with the Commission, at Washington, D. C.

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A new shop building containing 15,000 square feet of floor space is nearing completion at the Brown & Sharpe Manufacturing Company's place, and of this an entire floor, or 7,500 square feet, will be used for a new drafting room and engineers' offices. In addition to the usual side windows, the drafting room will be lighted from the top by dormer windows having a northern exposure. Adjacent to this, and next to one of the freight elevators, will be a place fitted up especially for photographing machine tools. This will be an exceptionally large and fine drawing room. Foundations are being put in for yet another building, which will be 385 x 50 feet, five stories high, with additional short wings or projections in which will be located the power plant, stairways and the washrooms, etc. In this new building there will be a washroom on each floor. Preparation is being made also for the building of a new foundry, although it is not yet fully determined just where it will be erected. At present 1,750 men are employed, and the buildings are crowded more than is desirable. The new building nearing completion will simply relieve this crowding somewhat, but the five-story building to be added will enable a total of nearly 3,000 men to be employed.

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It having been claimed that the first commercially operated electric railroad in the United States was built in Denver, Col., in 1888, a contributor to a New York paper stated in reply that in the city of Cleveland, Ohio, in the year 1884, an electric railroad of the sub-trolley type was constructed and put in operation by Walter H. Knight. Cars were run on this road regularly at speeds up to the maximum allowed by the city authorities, and were crowded with passengers carried on five-cent fares.

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It is estimated that Great Britain will, for the ensuing year, export 4,000 steam engines, aggregating 100,000 horse-power, for agricultural purposes.

# Commercial Review.

NEW YORK, SATURDAY EVENING,
July 22, 1899.

EXPORTS OF MACHINERY ACCORDING TO COUNTRIES.

We print herewith a table showing the amounts of several important lines of machinery of United States manufacture which were shipped to various countries, islands, etc., in the fiscal year ending June 30, 1898. We published the totals for most of those lines last summer, but the present statistics are in detail and will be found of interest. We hope to print a similar table for the fiscal year just closed as soon as the information is available.

LIGHT ON THE NILES-BEMENT-MILES DEAL.

Although many rumors have been current as to a union of interests between the Niles Tool Works Company, Pond Machine Tool Company, Bement, Miles & Co., and the Philadelphia Engineering Works, the evidence has not been regarded in machine-tool circles as adequate. We are able now to present an outline of the case, derived from such authority that it receives our sanction as a substantially accurate statement of affairs which are still in an unsettled condition.

For many years past attempts have been made to unify the interests of the Niles, Pond, and possibly Sellers, companies and the firm Bement, Miles & Co. The scheme was on the point of accomplishment at the time of the Pond-Niles coalition, when the relations of the Pond Machine Tool Company to their former selling agents balked proceedings.

This spring the consolidation project has come again to the fore and assumes a definite shape. The Niles Tool Works Company and their friends are in possession of a large amount of Pond stock. The latest proposition, which is said to emanate from them, is that a new New Jersey company be formed to purchase the Niles, Pond, Bement-Miles, and Philadelphia Engineering properties. The promoters are now engaged in trying to persuade the stockholders of the companies named to sell out. Bement, Miles & Co., who are a firm and not a stock company, have already agreed to sell at a fixed price, payable partly in stock of the new company. William Sellers & Co. (Inc.) have not been approached, so far as is known, and will probably not be a member. It is stated by a high authority that there is a fair likelihood that the scheme as indicated will be carried out within a month or two.

The members of the combination are expected to retain their respective individualities—names, trade marks, etc., with a common designation of some kind attached. "Niles-Bement-Pond Company" has been suggested. The working plan of the combine would be a single organization and main office, but a distribution of manufacturing work among the several constituents, each retaining those branches for which its equipment is best adapted and its designs most successful. For instance, the Philadelphia Engineering Works would continue to build traveling cranes, engines, etc.

It is claimed that there would be no inflation of stock, but that the shares of the new company would represent real values. It is understood that the present stockholders of the old companies would nearly all be in the new, and that each original concern would be represented in the new directorate. Mr. R. C. McKinney, of the Niles Tool Works Company, is talked of for president of the consolidation.

A GARVIN TOOL FACTORY IN GERMANY.

The Berlin branch of the Garvin Machine Company, New York, has been succeeded by a stock company, the Deutsche-Garvin-Maschinen-Fabrik Actiengesellschaft, which will continue the selling trade and also proposes to erect a factory for the manufacture of Garvin machine tools in Germany. The new company was formed with the co-operation of the Berliner Bank. It is capitalized at 2,500,000 marks (about $587,500). The personnel is a strong one, the directors being: Bank Director Klewitz, of the Berliner bank, chairman; August Kirschbaum, Solingen, vice-chairman; Hugo Stinnes, Mülheim a. R.; Alexander Lucas, Berlin; Oscar Hahn, of the Hahn'sche Röhrenwalzwerke, Berlin; George K. Garvin, president of the Garvin Machine Company, New York; Joseph Becker, of Becker & Co., railway constructors, Berlin. As manager was chosen Rudolf Kirschbaum, of the Wilkinson Sword Company, London.

The Garvins retain a stock interest, though not a controlling interest, in the new company. The Garvin Machine Company holds a contract for purchasing during a term of years all the American machinery for the concern. They will furnish until the factory is ready, all goods necessary for the conduct of the business. They will also build or purchase and supply most of the factory equipment, which will be distinctly American and modern, embodying many features of the New York Garvin plant.

The Berlin store of the company has been doubled in size, making it what is stated to be next to the largest American machinery store in that city.

CHICAGO MACHINERY MARKET.

The same activity in street railway equipment, both urban and inter-urban, prevails that has been noted for a long time. Plans are now in progress for the extensive improvement of the railways of several Western cities, requiring large units of power, and new projects are also in evidence. But it is in the transmission of power in plants that the greatest activity for the moment exists. There are in progress a number of negotiations for the electrical equipment of shops, the number being said to be larger than ever known before. One contract of this kind recently placed was that of the Advance Threshing Company, of Grand Rapids, Mich., the Westinghouse Electric & Manufacturing Company securing the business, the contract including generator and a considerable number of motors. Fresh interest is also awakened among the railways, several of the important Western systems now making inquiries about the more or less extensive application of electricity to their shops. The packing house interests are also among the best buyers. Swift & Co. have closed with the General Electric Company for an equipment of about 1,000 horsepower, both generators and motors, for their Chicago plant. The Cudahy Packing Company are in the market for electrical power for their South Omaha plant, and it is reported that The Schwarzschild & Sulzburger Company, of Kansas City, will build an establishment at Chicago, to be electrically equipped.

## Quotations.

NEW YORK, Monday, July 24.

Iron — American pig, tidewater delivery:—

| | |
|---|---|
| Pennsylvania irons: | |
| No. 1 X foundry | $20 60 @ 21 50 |
| No. 2 X foundry | 19 60 @ 20 50 |
| No. 2 plain | 18 60 @ 20 00 |
| Alabama irons: | |
| No. 1 foundry | 20 00 @ 20 50 |
| No. 2 foundry | 19 00 @ 19 50 |
| No. 3 foundry | 18 50 @ 19 00 |
| No. 1 soft | 20 00 @ 20 50 |
| No. 2 soft | 19 00 @ 19 50 |
| Foundry forge | 17 50 @ 18 00 |

Bar Iron—Base sizes—Refined, from mill, 2.10 @ 2.20c., on dock; refined, from store, 2.30 @ 2.35c.; common, from store, 2.20 @ 2.25c.

Tool Steel — Base sizes — Standard quality, 7 @ 8½c.; extra grades, 12 @ 14c.; special grades, 16c., and upward.

Machinery Steel—Base sizes—Ordinary brands, from store, in small lots, 2½c.

Cold Rolled Steel Shafting—Base sizes—From store, in small lots, 3½c.

Copper—Carload lots, Lake Superior ingot, 18⅜ @ 18½c.; electrolytic, 17¼ @ 17⅝c.; casting copper, 17⅛ @ 17⅜c.

Pig Lead—Carload lots, 4.55c., f. o. b., New York.

Pig Tin—In 5 and 10 ton lots, f. o. b., 31¼ @ 31½c.

Spelter—Prime Western in carload lots, 5.80 @ 6.00c., near future delivery at New York.

Antimony—In cask lots and over, Cookson's, 11c.; Hallett's, 9.80 @ 10c.

Lard Oil—Prime city, present make, the leading brand, 45 @ 47c., in wholesale lots.

## United States Exports of Machinery, etc., for the Fiscal Year ending June 30, 1898, shown according to Countries.

(Compiled from the Summary Prepared by the Bureau of Statistics, Treasury Department.)

| Country to which Exported. | Metal Working Machinery. | Electrical Machinery. | Locomotive Engines. | Stationary Engines. | Boilers and parts of Engines. | Pumps and Pumping Machinery. | Printing Presses and parts thereof. | Cycles and parts thereof. | Sewing Machines and parts thereof. |
|---|---|---|---|---|---|---|---|---|---|
| | Dollars. | Dollars. | Dollars. | Dollars. | Dollars. | Dollars. | Dollars. | Dollars. | Dollars. |
| Austria-Hungary | 31,280 | 38,492 | . . . . | 3,810 | . . . . | 25,265 | . . . . | 41,050 | 11,001 |
| Azores and Madeira Islands | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 196 | 300 | 109 |
| Belgium | 252,444 | 52,279 | . . . . | 8,144 | 3,678 | 64,009 | 13,689 | 130,016 | 62,431 |
| Denmark | 45,076 | 586 | . . . . | 517 | . . . . | 18,022 | 3,084 | 228,370 | 114 |
| France | 577,165 | 246,005 | . . . . | 10,391 | 4,680 | 74,764 | 27,422 | 482,680 | 102,809 |
| Germany | 1,669,828 | 122,851 | . . . . | 10,245 | 1,860 | 212,143 | 41,962 | 1,724,404 | 861,702 |
| Gibraltar | 20 | . . . . | . . . . | . . . . | . . . . | 57 | . . . . | 1,075 | . . . . |
| Greece | . . . . | 15 | . . . . | . . . . | . . . . | 1,496 | 10 | 1,108 | . . . . |
| Italy | 15,646 | 157,846 | . . . . | 120 | 3,503 | 19,241 | 1,317 | 89,522 | 17,666 |
| Netherlands | 74,717 | 1,710 | . . . . | 8,197 | 4,100 | 36,750 | . . . . | 251,918 | 101,124 |
| Portugal | 2,353 | . . . . | 63,438 | . . . . | 2,800 | 1,620 | 300 | 7,125 | . . . . |
| Roumania | . . . . | . . . . | . . . . | . . . . | . . . . | 196 | . . . . | 2,583 | . . . . |
| Russia—Baltic and White Seas | 138,418 | 16,810 | 260,960 | 4,110 | 2,037 | 110,782 | 1,920 | 35,642 | 13,114 |
| Black Sea | 1,941 | 11,932 | 222,550 | 5,455 | 70,500 | 63,946 | . . . . | 781 | 2,131 |
| Spain | 835 | 24,925 | . . . . | . . . . | 7,700 | 2,806 | . . . . | 2,765 | 59 |
| Sweden and Norway | 98,911 | 2,408 | . . . . | 2,200 | . . . . | 27,905 | 1,400 | 142,443 | 3,314 |
| Switzerland | 12,872 | 618 | . . . . | . . . . | 175 | 149 | 200 | 13,751 | . . . . |
| Turkey in Europe | 40 | . . . . | . . . . | . . . . | . . . . | 1,471 | . . . . | 1,053 | 580 |
| United Kingdom | 1,461,285 | 380,354 | 69,224 | 53,110 | 54,847 | 635,403 | 512,554 | 1,852,166 | 879,650 |
| Bermuda | . . . . | 1,000 | . . . . | 1,199 | 211 | 758 | 29 | 14,951 | 836 |
| British Honduras | . . . . | . . . . | . . . . | . . . . | 977 | 93 | . . . . | 1,061 | 3,882 |
| Dominion of Canada— | | | | | | | | | |
| Nova Scotia, New Brunswick, etc. | 3,099 | 1,862 | 17,265 | 1,879 | 15,207 | 6,867 | 4,192 | 64,755 | 15,164 |
| Quebec, Ontario, etc. | 10,909 | 167,141 | 518,584 | 110,122 | 91,349 | 73,665 | 108,252 | 512,997 | 109,263 |
| British Columbia | 772 | 9,157 | 4,500 | 4,141 | 10,513 | 12,656 | 2,968 | 33,650 | 13,301 |
| Newfoundland and Labrador | . . . . | . . . . | . . . . | . . . . | 2,862 | 160 | 240 | 2,601 | 3,444 |
| Central American States— | | | | | | | | | |
| Costa Rica | 2,487 | 706 | . . . . | 4,332 | 3,168 | 1,036 | 1,076 | 2,733 | 7,054 |
| Guatemala | . . . . | 86 | 12,240 | 570 | 3,044 | 1,464 | 869 | 797 | 7,527 |
| Honduras | 358 | 241 | . . . . | . . . . | 11,123 | 4,822 | 129 | 1,142 | 4,151 |
| Nicaragua | . . . . | . . . . | 3,800 | 4,296 | 2,687 | 705 | 326 | 2,005 | 3,626 |
| Salvador | . . . . | . . . . | 3,450 | 105 | 1,226 | 1,581 | . . . . | 529 | 4,072 |
| Mexico | 17,909 | 55,693 | 387,994 | 38,328 | 127,551 | 81,130 | 36,008 | 68,022 | 197,692 |
| Miquelon, Langley, etc. | . . . . | 17,988 | . . . . | . . . . | . . . . | . . . . | . . . . | 1,710 | 159 |
| West Indies— | | | | | | | | | |
| British | 88 | 1,329 | . . . . | 9,068 | 7,764 | 2,798 | 461 | 63,000 | 12,355 |
| Danish | 1,153 | 201 | . . . . | 2,560 | 901 | 793 | 7 | 4,046 | 232 |
| Dutch | . . . . | . . . . | . . . . | . . . . | 521 | 880 | . . . . | 1,760 | 1,839 |
| French | . . . . | . . . . | . . . . | . . . . | 2,000 | 558 | . . . . | 141 | 1,271 |
| Haiti | . . . . | 3,566 | . . . . | . . . . | 1,966 | 333 | 212 | 495 | 938 |
| Santo Domingo | . . . . | 871 | 10,450 | 1,000 | 5,283 | 1,489 | 614 | 1,171 | 1,282 |
| Spanish—Cuba | 1,332 | 11,588 | 49,550 | 1,553 | 52,011 | 4,500 | 1,959 | 9,214 | 2,785 |
| Porto Rico | . . . . | 23,632 | . . . . | 952 | 2,925 | 546 | 729 | 3,359 | 3,120 |
| Argentina | 8,565 | 217,835 | . . . . | 22,683 | 16,050 | 34,461 | 160 | 90,229 | 77,188 |
| Bolivia | . . . . | . . . . | . . . . | . . . . | . . . . | 111 | . . . . | 670 | 419 |
| Brazil | 8,241 | 58,846 | 443,531 | 5,300 | 166,486 | 5,461 | 2,219 | 98,482 | 95,966 |
| Chile | 8,627 | 16,298 | . . . . | 8,033 | 17,665 | 2,834 | 2,178 | 14,206 | 7,663 |
| Colombia | . . . . | 2,064 | 43,772 | 9,781 | 14,405 | 11,324 | 4,988 | 15,684 | 82,359 |
| Ecuador | . . . . | 12,927 | 2,000 | . . . . | 797 | 2,555 | 1,817 | 2,512 | 21,005 |
| Guianas—British | 13 | 180 | . . . . | 275 | . . . . | 3,309 | 36 | 15,203 | 2,090 |
| Dutch | . . . . | . . . . | . . . . | . . . . | 816 | 379 | 97 | 910 | 279 |
| French | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 60 | 810 |
| Paraguay | . . . . | . . . . | . . . . | . . . . | . . . . | 17 | . . . . | . . . . | . . . . |
| Peru | 5,044 | 24,640 | 11,601 | 3,313 | 17,316 | 7,780 | 1,976 | 8,732 | 37,156 |
| Uruguay | . . . . | 12,031 | . . . . | 920 | 500 | 1,036 | . . . . | 3,850 | 14,342 |
| Venezuela | . . . . | 4,484 | 5,000 | 1,839 | 5,652 | 3,815 | 2,652 | 2,823 | 17,525 |
| Aden | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 180 | 606 | . . . . |
| China | 19,488 | 1,868 | 121,000 | 790 | 12,402 | 5,265 | 232 | 27,449 | 3,848 |
| East Indies—British | 85,798 | 19,865 | 13,435 | 2,317 | 1,385 | 68,428 | 20,373 | 90,388 | 4,363 |
| Dutch | 6,761 | 80 | . . . . | . . . . | 6,729 | 11,283 | . . . . | 13,368 | 36 |
| French | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 100 | . . . . |
| Hong Kong | 8,316 | 502 | . . . . | 300 | . . . . | 489 | 588 | 7,636 | 2,708 |
| Japan | 10,077 | 165,398 | 1,283,865 | 27,911 | 51,169 | 25,170 | 2,580 | 88,905 | 5,883 |
| Russia, Asiastic | . . . . | 1,483 | . . . . | . . . . | 20,726 | 419 | . . . . | 85 | 910 |
| Turkey in Asia | . . . . | . . . . | . . . . | . . . . | . . . . | 1,595 | . . . . | 925 | 993 |
| British Australasia | 11,969 | 83,971 | 19,400 | 14,583 | 14,702 | 104,140 | 70,840 | 309,006 | 274,154 |
| French Oceanica | . . . . | . . . . | . . . . | . . . . | . . . . | 44 | . . . . | 4,967 | 2,697 |
| German Oceanica | . . . . | . . . . | . . . . | . . . . | . . . . | 40 | . . . . | . . . . | . . . . |
| Tonga, Samoa, etc. | . . . . | . . . . | . . . . | . . . . | . . . . | 46 | . . . . | 272 | 14 |
| Haiwaiian Islands | . . . . | 6,212 | 8,700 | 3,796 | 61,135 | 138,317 | 585 | 52,072 | 16,757 |
| Philippine Islands | . . . . | . . . . | . . . . | . . . . | . . . . | 116 | . . . . | . . . . | . . . . |
| British Africa | 757 | 40,459 | 76,700 | 2,704 | 13,380 | 85,443 | 615 | 184,503 | 9,489 |
| Canary Islands | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 219 | 252 |
| Liberia | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 39 |
| French Africa | . . . . | 21,800 | . . . . | . . . . | . . . . | 170 | . . . . | . . . . | . . . . |
| Portuguese Africa | . . . . | . . . . | 1,575 | 3,721 | 1,426 | 586 | . . . . | 985 | 296 |
| Turkey in Africa—Egypt | 14,356 | 4,843 | 229,126 | . . . . | 1,052 | 3,437 | 274 | 6,059 | 408 |
| Totals (including a few miscel. countries) | 4,618,683 | 2,052,564 | 3,883,719 | 398,570 | 927,552 | 2,023,034 | 874,515 | 6,846,529 | 3,136,364 |

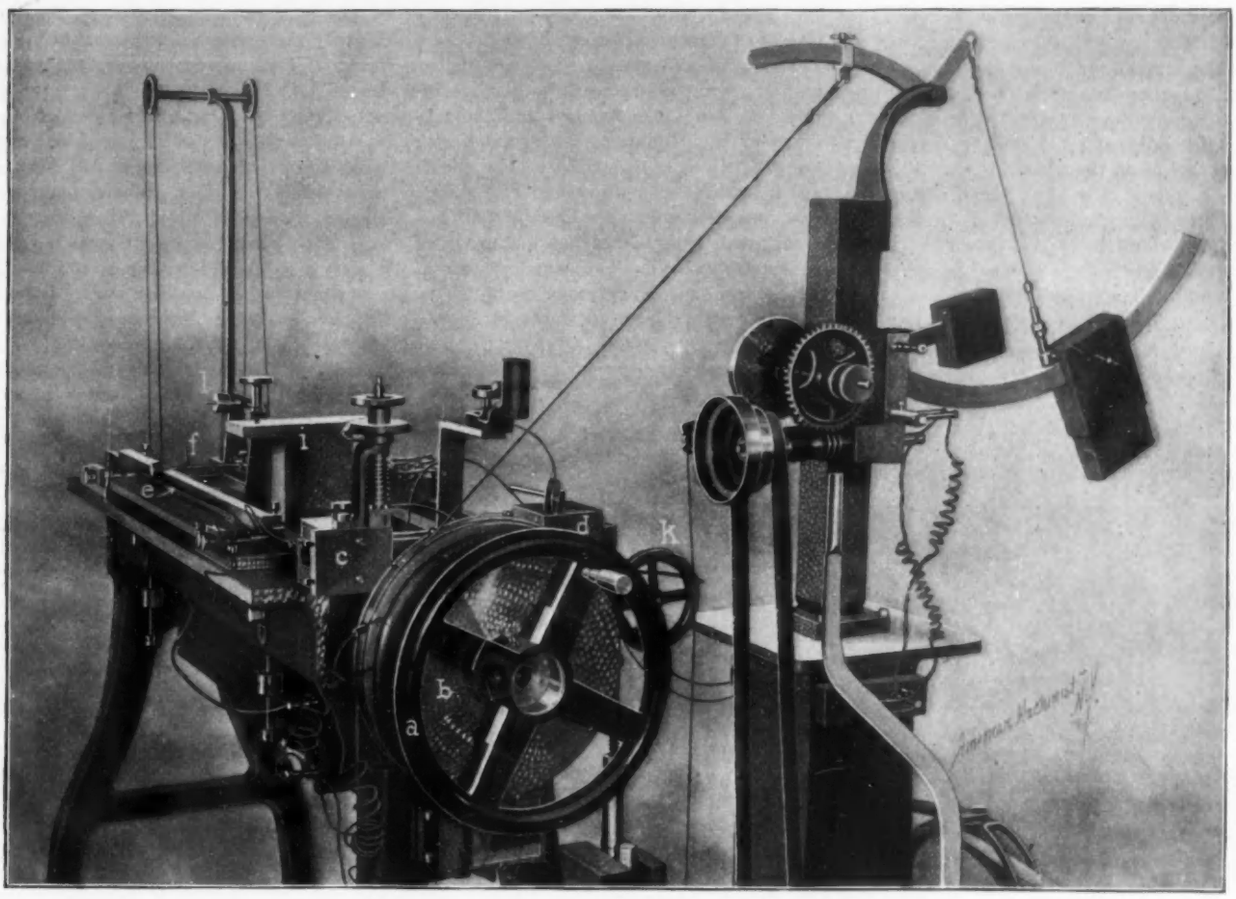


FIG. 1. THE ROGERS DIVIDING ENGINE, FRONT VIEW.

## Some of the Products of Professor W. A. Rogers' Precision Lathe—I.

In the issue of May 25 we published a description of Professor Rogers' lathe and of the methods employed for compensating the errors of its lead screw. Some photographs and information received from Webber & Philbrick, of Waterville, Me., who constructed the machines, enable us to present herewith a description of some of the more important pieces of work done on the lathe before its unfortunate destruction by fire. As with the lathe, exact information on some points involved in the construction and use of these machines is lacking. Some things of this nature must be inferred, and in consequence we can claim substantial accuracy only for this article.

### DIVIDING ENGINE.

Figs. 1, 2 and 4 represent the dividing engine, of which two were made. The one from which the photographs were made, while complete as a machine, has not had the errors of its screw determined and compensated. This, however, will not interfere with an understanding of its functions and operation.

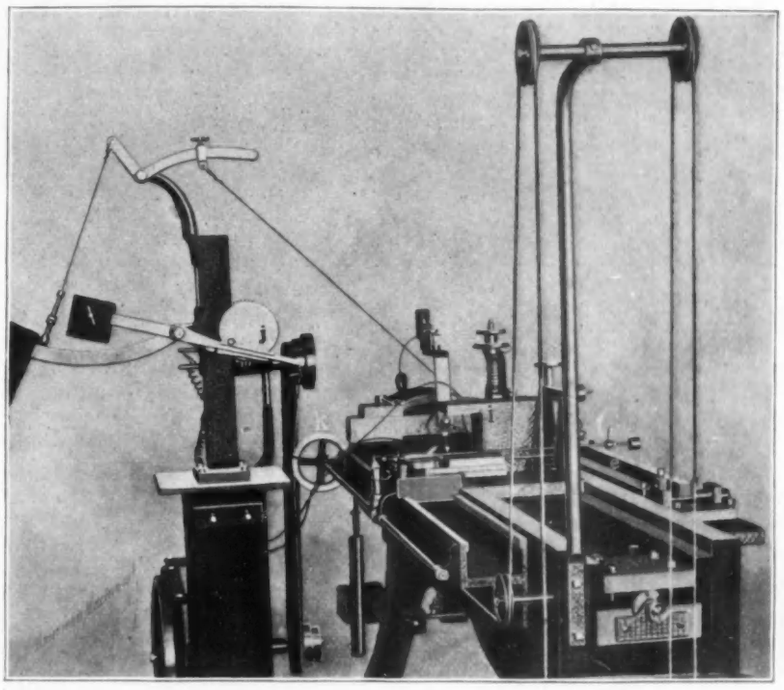


FIG. 2. THE ROGERS DIVIDING ENGINE, REAR VIEW.

The office of a dividing engine is to take a standard dimension, as an inch, from a graduated bar and to reproduce and repeat it on a second bar with such subdivisions as may be desired. In addition to this the present machine is made to act as a comparator for comparing line and end measures.

Considering the machine in its dividing and ruling functions, its essential parts are a screw of great accuracy, a system of adjustable stops for determining the ex-

tent of rotation of this screw between the graduations to be made, a marker (moved by the screw) for ruling the lines on the bar to be divided, and a driving apparatus for turning the screw by successive steps and for operating the marker during the intervals when the screw stands still.

Fig. 1 is a view of the head end of the machine. The hand-wheel *a* and the disk *b*, just behind it, serve to turn the screw by hand and power, respectively, the screw extending lengthwise through the entire machine. One of the adjustable stops will be seen at *c*, with a bracket and micrometer screw head for adjustment mounted on it. The stop for limiting the movement in the opposite direction is at *d*. The bar to be graduated is at *e*, the diamond which does the marking being held in a block *f*. The driving mechanism is an auxiliary machine at the right. Fig. 2 is a view from the opposite end of the machine, the parts having the same letters as in Fig. 1. The mechanism for operating the diamond is shown more clearly than in Fig. 1, but a still better view of this portion of the machine is given in Fig. 4.

The original standard does not appear in Fig. 1 or 2, as the work with it is supposed to have been finished and the machine to be in readiness to proceed with the graduation of a new bar. The standard is, however, in position in Fig. 4 at *g*, just outside the bar *e*. Eccentric adjustments with capstan heads *h* are provided to level the bars. The standard bar is read through a microscope mounted on the marker carriage, also seen in Fig. 4. This microscope is fitted with an eyepiece micrometer, the hair-line of which, being brought to exact coincidence with the successive dividing lines of the standard, enables the marker carriage to be moved exact inches. The block *i* on which the microscope is mounted, as well as the stops *c* and *d*, are solid chunks of cast iron, and illustrate Professor Rogers' belief in the value of simple mass in work of this kind.

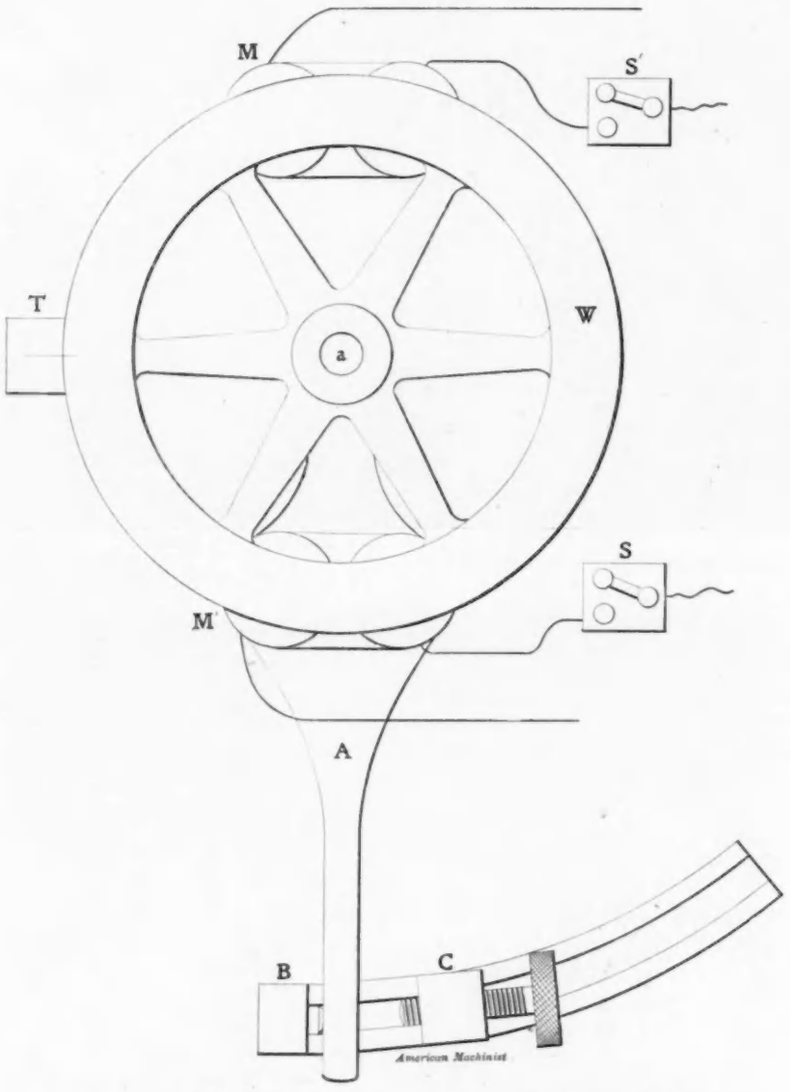


FIG. 3. THE "STEP-AROUND" METHOD OF DIVIDING INDEX PLATES.

When ruling a bar, exact movements of the marker are made along the machine by the screw, the ruling of a line on the bar following each movement. In order that the work may be correct, the screw must be correct, or its errors must be known and compensated. The screw is of course the part made on the precision lathe described in the article of May 25, and is of a very high degree of accuracy. Professor Rogers was not one, however, to depend on the accuracy of a screw, even when made on such a lathe as his own, in which the lead screw errors had been compensated. Accordingly, this machine is fitted with the same means for correcting the errors of its screw as were described in the article on the lathe—the nut which drives the carriage being a "free nut," which is turned backward or forward as the carriage moves along the machine by a correction cam. In the dividing engine this cam is out of sight, being under the machine, the free-nut arm projecting directly downward, and being held in contact with the cam by a small weight or spring. Those who have read our article on the lathe will need no further description of this feature of the dividing engine.

Supposing an inch of the standard bar is to be reproduced on a second bar, but subdivided into, say, 100 parts, it is clear that with a lead screw having five threads to the inch, and granting the screw to be correct or correctly compensated, complete turns of the screw will divide the inch into fifths. To get the division into hundredths, the screw must be turned by an exact twentieth of a revolution between each division. This division of the circle into twenty (or any other number of) parts is accomplished by the "step-around" process which originated with Professor Rogers, and which, in combination with his system of correcting the errors of the screw, forms his most important contribution to the art of exact measurements. The "step-around" process was described in our issue of September 8, 1898, in an article by Mr. H. B. McCabe, showing how Professor Rogers and Mr. Geo. F. Ballou divided the index wheel of the Cornell University dividing engine, and the accompanying illustration, Fig. 3, is reproduced from Mr. McCabe's article. *W* is the wheel to be divided. *T* is a stationary block containing the zero mark. *M* is a stationary magnet in contact with the rim of the wheel. *A* is a swinging arm carrying a magnet *M'*, also in contact with the rim of the wheel and playing between stops *B* and *C*, of which *C* is adjustable. Starting at zero, as shown, *M'* being energized and *M* not, if *A* is swung from *B* to *C*, the wheel will be carried with it. Energizing *M* and releasing *M'*, the wheel will remain stationary while the arm is swung back, when, the process being repeated, a new movement of the wheel will be made. By repeated trial and adjustment of *C*, the zeros

may obviously be made to come together again when the desired number of movements has been made, and this will show that the extent of each movement is correct for the desired number of divisions.

In the present machine the stops *c d* correspond to *B* and *C* of Fig. 3. Stop *d* is provided with means for coarse adjustment, and *c* with a fine adjustment, composed of a wedge moved vertically by the micrometer screw—the adjustment being thus compounded and correspondingly delicate. The adjustment of these stops being made for a twentieth of a circle by repeated trial, the machine is obviously ready to go ahead with the graduation of its bar into hundredths, and by the same means any required number of subdivisions could be made. We are not, however, limited to the dividing of a single circumference. Under the assumptions of a five-thread screw and twenty divisions to the circumference, a hundred movements should turn the screw five complete turns and advance the carriage an inch. With the hair-line microscope and standard bar, the error, if any exist, may be found by taking readings before and after the hundred movements, and, indeed, this may be repeated at every inch to the end of the standard bar, forming the sharpest possible test of every feature of the machine.

The principle of construction being shown, it remains to explain how the machine is operated, for, once the adjustment of the stops is made, the machine is entirely automatic in action. At the right in Fig. 1 and at the left in Fig. 2 will be seen a post carrying some mechanism. By the driving wheel at the bottom, the cone pulleys, and the worm gearing, the crank disk *j* is revolved. This disk carries a crank pin on the side shown in Fig. 2, against the lower side of which two levers rest, being held in contact by the counter weights on their opposite ends. When the machine is in operation these levers will obviously oscillate about their fulcrum pin. Through the cord connections shown, one of the levers operates the disk *b*, which corresponds to the arm *A* of Fig. 3, while the other lever operates the marker. The cord from one of these levers goes directly downward and wraps around a small pulley *k*, seen in Figs. 1, 2 and 4, and to its free end has a weight attached. This pulley is secured to the shaft which runs along the rear side of the machine and operates the marker. As the crank pin rises, the counter weight on the arm causes the arm to follow the crank pin, to pull the cord, and to turn the pulley. As the crank pin depresses the arm and slackens the cord the weight hanging from the pulley turns it in the opposite direction—the actual movement of the pulley in both directions being thus caused by the weights. The same action is applied to the disk *b*—the cord from which its return weight is suspended being seen in Fig. 1, the weight being, however, below the limit of the picture. In the case of the marker pulley, the amount of movement is constant, but with the disk *b* an adjustment is obviously necessary, and this is provided at two places through the arc-shaped ends of its crank disk lever and of a supplementary lever mounted at the extreme top of the post. It is, however, clearly impossible to make this adjustment with sufficient accuracy by such means, and no such accurate adjustment is attempted. The adjustment is so made as to supply a slight surplus of movement at both ends. As the crank pin goes up, the lever follows it until the stop on disk *b*, Fig. 1, engages the stop *d*, when further movement of the lever ceases and the crank pin leaves its lever. Similarly, when the crank pin goes down, the return weight hanging from disk *b* turns the disk until its stop engages with stop *c*, the remaining stroke of the crank pin causing the cord to slacken. The reader will observe that the crank motion, by slowing down at the ends of the stroke, causes the stops to engage with very slight impact, as is obviously highly desirable.

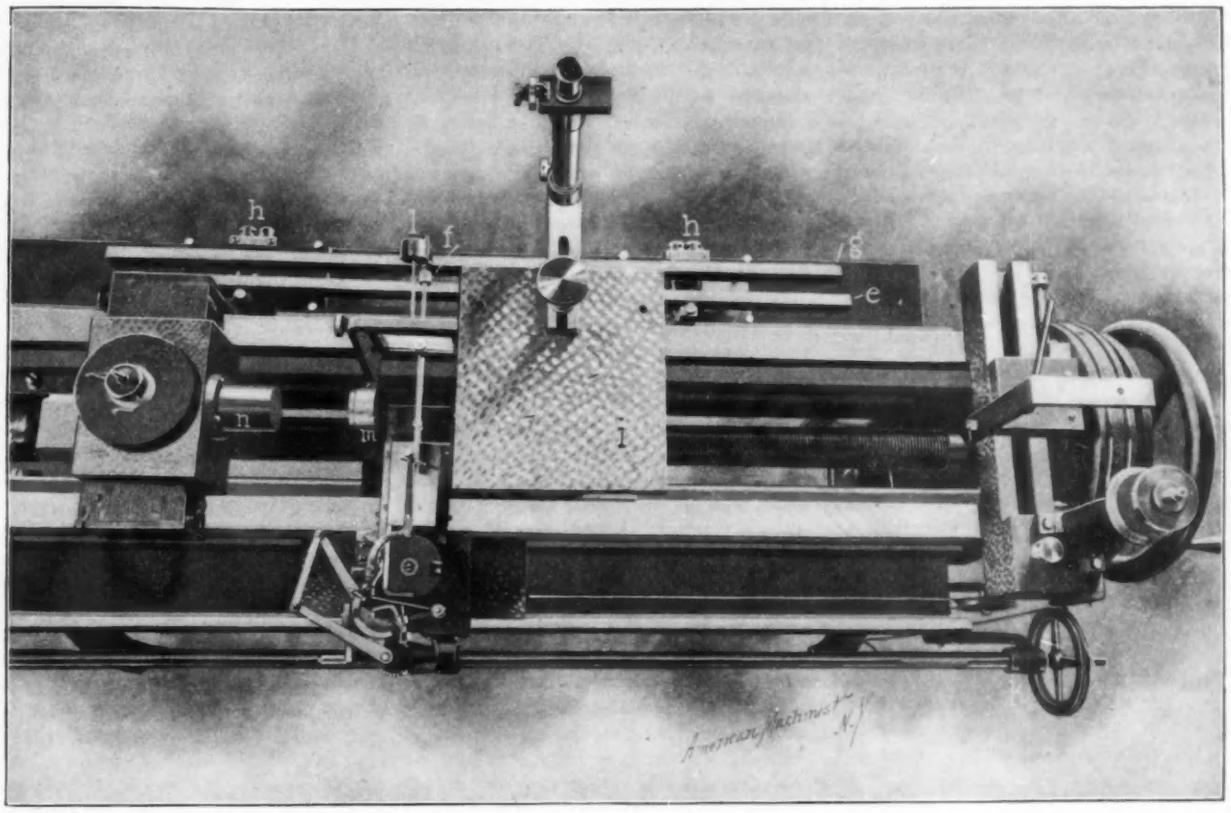


FIG. 4. PLAN VIEW OF DIVIDING ENGINE, SHOWING MARKER.

The movement of the levers is also made to make and break the electric connections for operating the magnets. The details of this part of the machine do not appear, though the wires for the current are in evidence in the pictures. The mag-

nets themselves are not in sight, but their method of operation will be clear from Fig. 3.

The marker is shown more in detail in Fig. 4, which shows it to be a device of some complexity. Much trouble was experienced in obtaining a satisfactory marker, and the present construction—the work of Mr. Philbrick—is the outcome of many trials. We shall make no attempt to follow all the actions of this marker; but the rod which carries the diamond will be seen to be carried by a swinging frame, which is reciprocated by a mechanism driven by a pair of miter gears, of which the driver takes its motion from the shaft to which pulley *k* is attached. The diamond holder *f* appears in all the halftones, the weight of this block being adjusted to give the required depth of line. A second weight *l*, attached to the swinging frame, effects the inward stroke of the marker, and it is during this inward stroke that the ruling is done—it being quite impossible to do fine ruling by a pushing stroke. It may be mentioned that the complexity of the marker is due to the necessity for raising the diamond during the non-cutting stroke, and to the necessary adjustments. The length of the lines must be adjustable and at both ends, as well as the position of the lines as a whole across the bar. The different lines of a set must also vary in length as on a common scale. It will be understood, of course, that the ruling is very fine, being only just visible to the unaided eye when viewed under the most favorable lighting conditions.

The lead screw of the machine appears in Fig. 4, as well as the stops *m* and *n*, for use with end measures when comparing them with line measures. The upright at the tail end of the machine, with the system of pulleys, cords and weights, is to assist the movement of the carriage, and so relieve the screw of friction and wear.

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## The Machinists' Union on Piece Work and the Premium Plan.

Many of our readers are aware that piece work and the premium plan were important subjects of discussion at the Buffalo convention of the International Association of Machinists held in May last, and they will be interested in knowing the action taken by the convention. We therefore reproduce from the Monthly Journal of the Association for June so much of the proceedings of the convention as relates to this subject.

These extracts comprise (1) the remarks by the Grand Master Machinist in his annual report; (2) the report of the Committee on Law, which was not adopted, together with the discussion thereon; and (3) the report of a special committee, which was adopted, together with the discussion preceding the vote.

The Grand Master Machinist's remarks were as follows:

"One of the most important matters to be considered by the delegates to this convention is the question of piece-work and other plans of paying for work performed by machinists.

"There is no denying the fact that piece-work and the premium plans are constantly growing in our trade. Although we have succeeded in many instances in preventing the introduction of piece work, yet the volume of the same is increasing. It is useless for us to any longer hide our heads under a bushel, refusing to squarely face the matter. There is no one who believes more firmly than do I that piece work is detrimental to our trade; it not only works injury to the tradesmen, but results disastrously to the employer. We might as well follow the example of that famous bird, the ostrich, that buries its head in the sand, believing that if it cannot see it cannot be seen, as to continue our present method of fighting piece work.

"First, because we allow our members in some shops to work under the system; although the same firm may own the shop across the street, our members cannot accept the system there under our constitution. When we go to employers with this state of affairs existing, we are placed in a most ridiculous position.

"During the past two years we have spent more money and devoted more time of the officers to the question of piece work than to any other portion of our trade. In many instances our efforts failed. As a result many lodges were lost to the association. I call your attention to the conditions prevailing on the Chicago, Burlington & Quincy Railroad, where we lost four lodges because of the introduction of piece work. We did all in our power to assist our lodges located on the road to resist the introduction of piece work, but there being a number of our members who were desirous of accepting the plan, made it impossible for us to do anything. In fact, letters were received at headquarters from our lodges on the system, insisting that the Grand Lodge keep its hands off the affair.

"Lodges have been lost in other sections of the country, not because the Grand Lodge made no effort to prevent the introduction of the system, but in many instances because when the Grand Lodge tried to prevent it, those who were desirous of accepting piece work succeeded in disrupting our lodges.

"A new plan is now being tried in some localities which, in the main, does away with the old practice of piece work, and introduces what is known as the 'premium plan' of paying for work performed.

"This guarantees to the men that they will receive their regular wages whether the same is made by them or not.

"Mr. F. A. Halsey, associate editor of the 'American Machinist,' in the March 9 issue of that paper, gives a plan which is being rapidly taken up by the manufacturers."

The Committee on Law presented the following report:

"Recognizing the great inroads that the premium plans and the two or more machine systems are making into the machine shop of the present day, we believe it is essentially necessary that legislation of a definite nature should be enacted whereby the I. A. of M. can successfully manage and control them. We realize that to further combat the system of premium plans will be suicidal on our part when we consider the fact of the many members of our organization being engaged in them at the present time.

"Your Committee on Law realize that this is a knotty problem to solve in presenting a plan whereby we can successfully deal with this question on the start. We do believe, however, that the plan herewith submitted will, in a measure, serve as a guide wherever the system is in operation, or may be introduced in future. We might also add that practical experience is the greatest teacher in all things and during the next two years we will get the benefit of it, at which time we will be better able to amend or improve the plan herewith submitted.

"Members of the International Association of Machinists can accept premium work under the following conditions:

"1st. That each employee shall be guaranteed his regular day's work wages.

"2d. That the time limits shall never be lower than the average time made with the same tools under the day's work plan.

"3d. That no one shall be discharged because of failure to reduce his time below the limits.

"4th. That, in addition to his regular wages, each employee shall be paid one-half of his regular hourly rate, for each and every hour he may reduce his time below the prescribed limits.

"5th. That the limit once fixed shall not be lowered except through the introduction of new methods of doing the work.

"6th. That all the premiums shall be paid within two weeks of completion of the work upon which they were earned.

"7th. That at the end of one year's time the plan will be withdrawn from all those not wishing to continue working under it.

"8th. That if withdrawn the employee shall not be required to work at the same rate of speed without an equivalent in wages.

"9th. Any member of the I. A. of M. working at the premium work system shall not be permitted to earn more than 10 per cent. in excess of the average wage paid in that locality. Shop committee shall ascertain each pay day the amount earned by each member under the premium-work system. All over 10 per cent. he may earn shall be forfeited to the

lodge of which he is a member, and report same to the Financial Secretary of the lodge.

"10th. No member of the I. A. of M. shall be permitted to run two or more machines except where an agreement has been entered into with organization and the firm. Such agreement shall only apply to special machines and shall require all machinists to be members of the I. A. of M."

The discussion of this report was as follows:

Phillips said no union man could entertain the idea of piece work or running two machines.

Warner claimed that piece work had come to stay. We must either abolish it or control it. The only way to abolish it was by the co-operative commonwealth. We were not ready for that yet. That in a shop in New York the men worked piece work or premium plan and that all they received above $18 per week was donated to a defence fund. The last clause of the plan, as submitted by the committee, provided for an agreement on the part of the organization and the firm. We could get agreements with nine-tenths of the firms in this country. He moved that we adopt last clause of committee's amendment and insert "or accept piece work" after "two or more machines."

Ingram said we had whipped piece work in Chicago, and now New York was trying to straddle it on us again.

Patterson said it must be decided what running two machines was.

Garner said in his section they had tried to introduce piece work. Man after man had quit work because of it. Now they had got it where the master mechanic said: "We are going to give up piece work; it is causing us too much trouble."

Goodman said it had been for years in operation on the Norfolk & Western system. They saw nothing to do but accept it.

Keeley said he came from a shop which was under the management of the Chicago, Burlington & Quincy. The entire system was working piece work. They had waited upon the manager and asked that piece work be abolished. He had told them it had come to stay. They had again introduced a petition. The delegate who was to have been at this convention was at home now waiting for a reply from the superintendent of motive power. With the co-operation of the machinists on the line, they hoped to be able to drive out piece work.

Daglish thought it was a hard nut to crack. But the piece work could be abolished. They had done it in one shop. When the manager was first approached about it, he only laughed, but they had dinged at him, and donged at him, until he had abolished it.

Wisler said piece work was being worked on the Chicago, Burlington & Quincy system. Thousands of members were working under it. The plan submitted by the committee gave a year in which to try the agreement. At the end of that time it could be withdrawn.

Lewellyn said if we contracted a disease for a year, we could not get rid of it. It was so with piece work; if we worked it for a year we could not then drop it. He had come to the convention pledged to vote against it.

Donivan said he was opposed to piece work. He would be censured should he return to his lodge and report not having opposed it.

Powell said his lodge had fought piece work tooth and nail. He distinctly wanted to go on record as against the system.

Lockhart wanted to testify in regard to piece work. Every inducement had been offered them to accept piece work, but they had refused.

Reynolds, No. 436, said they had driven out piece work by a man taking four weeks to do a job which he could have done in two, and so on.

Warner said he would withdraw his motion. It had brought out healthy discussion, and would perhaps bring about a substitute.

Phillips and Haas moved that it be laid on the table. Lost.

Gregg said no piece work existed in his locality, but he was here to legislate for what would benefit the I. A. of M. at large. Moved that the G. M. M.'s report of piece work be read.

Warner said he had not read G. M. M.'s report, but piece work was here and bound to stay, so let us settle the question to-day, or two years hence we would not have ten delegates to convention.

(G. M. M.'s report on piece work read.)

The G. M. M. then addressed the convention, saying after great study he felt it was his duty to bring this matter up, as the manufacturers of the country are making strenuous efforts to introduce the piece-work system. He then explained the difference between the piece-work system and what is known as the premium plan. He reported several interviews with firms, and advised the convention to adopt some law that would allow the officers of the I. A. of M. to cope with this evil. He referred to the article of Mr. Halsey, editor of the "American Machinist." Said he hoped some means would be devised to regulate the system, as we had lost nearly all our lodges on the Chicago, Burlington & Quincy from it.

Warner asked to submit a proposition, read same, and asked the G. M. M.'s opinion.

York asked G. M. M. if, under the system, a man spoiling work would have to pay for it.

Foster said the Pan Handle road was offering great inducement to men to do piece work.

Moved by Conlon, G. E. B., that a committee of five be appointed to draft a plan to govern this system. Carried.

No vote appears to have been taken on this report, but we judge the appointment of a special committee to be equivalent to rejection. This special committee at a later session brought in the following report:

"Your committee beg leave to report that, after due deliberation, we have become convinced that, under the present conditions existing in some parts of our country, we are forced to provide some legislation that will compromise in a manner between those who ask for protection where piece work exists and those who appeal to us for a law which will prevent its introduction; and we further realize the fruitless attempt to drive the monster from among us, at the Kansas City convention, when Section 3, Article XXII, in our Constitution became a law, and which from its date has been a dead letter. We therefore annul Section 3, Article XXII, by striking all out and substituting the following:

"That our judicial officers be given discretionary power to treat with employers where piece work now exists with I. A. of M. members, and to make agreements as prescribed by the premium system, and thereby control and eventually abolish piece work in any form."

Moved by Foster and Madigan that the report of the committee be adopted.

Wisler said there was no provision in this report to prevent a man from doing piece work. No fine was placed on him. If you want to stamp it out, make it cost a man so much that he will not want to do it.

Senne said the committee had in mind, in making this report, the recommendation of the Law Committee.

Ingram said the committee had discovered that we have been unable to handle the piece-work system as adopted at our last convention. The plan adopted at our last convention was thrown down by the referendum vote. He opposed legalizing it in the shop where he was working. It forced men who were honorable to compete with men who were dishonorable enough to work it in order to make a few more dollars.

Lockhart said the plan submitted would control it as much as it ever had been controlled. This prevented piece work from spreading where it does not exist. The way to put that law into operation is by giving the executive officers power to make contracts where piece work now exists. Provision was made for the judicial officers to have power to procure agreements from manufacturers where it now exists and put in the premium plan.

Phillips inquired if this power invested in the Grand Lodge officers would allow

them to make contracts with the firm in Cincinnati.

Lockhart said: "If piece work does not exist there, it cannot be introduced."

Kelly said the plan was the best thing we could do. It gives all the protection possible to Chicago. It gives the executive officers a chance to prevent piece work going any further. It cannot come into places where it has been stamped out.

Jennings, No. 6, said there was too much in the report. Let us not put anything in our constitution about it. Put it in the hands of the executive officers to accept where it cannot be helped, and stamp it out where possible.

Brown, No. 421, believed the premium plan was just as bad as piece work. In his city the premium plan was introduced in a shop. The men earned $18 and $24 a week. They did not know where to stop. The company had to cut them down. He did not wish to see the premium plan endorsed one iota.

Lockhart said the committee realized the importance of the question—that it was the most complicated one that had come before the convention. We do not want piece work in any form, but we must provide for it where it exists. It was not right to have a law that was violated, as the past law has been. To substitute the premium plan where piece work now existed was a compromise between those who did want piece work and those who did not.

Williams believed the report of the committee was fair. We are not in a condition to-day to antagonize the shops that are already working piece work.

Goodman said it was a matter of organization. He worked in a piece-work shop. The men agreed among themselves how much they would earn; but he was opposed to the plan in principle.

Mount stated he was opposed to the piece-work plan, but could see no way out of it.

Question called. Report of committee adopted.

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## The Friction of Compressed Air in Pipes.

BY J. E. JOHNSON, JR.

Numerous articles on the above subject have appeared in the columns of the "American Machinist" and elsewhere, all of which go back to one parent stem, not far removed, and that is that the friction varies as the square of the velocity and inversely as the diameter of the pipe. To this have been added the factors for length of pipe and for the density of the fluid; and, since the velocity varies inversely as the square of the diameter, if we assume that the loss of pressure or friction increases with the density, we can write down at once:

$$p_1 - p_2 = \frac{Q^2\, l\, w}{k\, d^5}$$

in which

$p_1$ = initial pressure,
$p_2$ = terminal pressure,
$Q$ = volume of fluid,
$l$ = length of pipe,
$w$ = density of fluid,
$d$ = diameter of pipe,
$k$ = a constant.

As long as we are dealing with liquids which do not change their volume appreciably under ordinary pressures, the value to assign to $Q$ is plain enough, it being the same at all points; but when we come to gases this is the point on which confusion begins at once; since, for flow to take place, there must be a difference of pressure at the two ends of the pipe, and when there is a difference of pressure there is also difference of volume, and $Q$ becomes a variable quantity. This is known by everyone, but temporarily overlooked in considering this subject by some who have written about it.

While for most cases of air transmission for power purposes, in which the loss of pressure, and hence increase of volume, is small, the effect of this increase may be ignored and still give a working formula for such cases, it would seem to be obvious that the effect of the increased volume cannot be ignored in any strictly rational formula which is to be applicable to all cases. Sufficient proof of the inaccuracy of the formulas which ignore it may indeed be had from the formulas themselves. If in a long pipe line with considerable loss of pressure the loss be calculated first for the pipe as a whole and then in sections—the density and volume being calculated anew for each section—the results will not agree, although they should do so if the formula were sound. Again, if the initial pressure necessary for an assumed terminal pressure be calculated and then the process be reversed—calculating the terminal pressure due to the initial pressure found by the first calculation—the result will not agree with the terminal pressure given at the start, which it obviously should do if the formula were sound.

These considerations explain the "compressed-air paradox" published by Mr. Frank Richards in the issue of April 16, 1896—the apparent paradox being due to the use of a formula which did not properly apply to the large losses of pressure assumed.

Let us side-track the whole difficulty by considering always the volume of free air being transmitted, which is, of course, the same throughout, and denote the number of cubic feet per minute flowing by $V$, and let $p$ denote the pressure at any point, $p_1$ and $p_2$ being, as before, the initial and terminal pressures, except that these are now to be taken not as gage, but as absolute pressures.

Now let us assume that, for a very short length of pipe, so short that the change of pressure in passing through it is negligible, the friction is proportional to the square of the actual volume flowing, to the length, and to some power of the density (which may be positive, negative, or zero, as experiment may determine), and inversely proportional to the fifth power of the diameter of the pipe. Let the constant to change the proportionality into an equation be $k$, and leave its value to be determined from experiment also.

These suppositions are so liberal that they cover every formula which has been seriously considered for application to this purpose, and depend only upon the most generally accepted and well-proven facts, except that the variation of friction with variations in density may not follow any constant power of the density; but for general engineering purposes I think that this assumption is entirely allowable.

Then by the methods of the calculus* we have

$$p_1^{\,m} - p_2^{\,m} = k\,\frac{V^2\, l}{d^5}$$

which is a working formula as soon as we have determined $m$ and $k$.

As the result of a long investigation of the probable cases, on consideration of the molecular action of the gas, and of the published results of experiments, the value of $m = 2$ was adopted for use in the present article, and is probably correct.

It is probably not worth while to go into this investigation in detail here, as it would take up considerable space without being of interest or value to more than a handful of readers.

We have then

$$p_1^{\,2} - p_2^{\,2} = k\,\frac{V^2\, l}{d^5}$$

This value of $m$ corresponds with the assumption that the friction for a small loss of pressure varies as the density of the air transmitted, and in fact this formula may simply be considered as the D'Arcy formula corrected for the variation in pressure, with consequent variations in density and velocity, during trans-

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* In the first equation, if we substitute for $w$, the first power of the density, $w^n$, its $n$th power, according to our assumption, we have the expression of these suppositions in algebraic form:

$$p_1 - p_2 = k_1\,\frac{Q^2\, l\, w^n}{d^5}$$

But $Q$ is proportional to the volume of free air directly and to the absolute pressure inversely; so for $Q^2$ we may put $\frac{V^2}{p^2}$. Similarly the density is directly proportional to the pressure, so for $w^n$ we may put $p^n$. Then we have:

$$p_1 - p_2 = k_1\,\frac{V^2}{p^2}\,\frac{l}{d^5}\,p^n = k_1\,\frac{V^2\, l}{p^{(2-n)}\, d^5}$$

For a very small loss of pressure and short length of pipe $p_1 - p_2$ becomes $dp$ and $l$ becomes $dl$, giving:

$$dp = k_1\,\frac{V^2}{d^5}\,\frac{dl}{p^{(2-n)}}$$

$$\text{or } p^{(2-n)}\,dp = \frac{k_1\, V^2}{d^5}\,dl$$

Integrating between the limits $p_1$ and $p_2$ and between zero and $l$, we have:

$$\frac{p_1^{(3-n)} - p_2^{(3-n)}}{(3-n)} = k_1\,\frac{V^2\, l}{d^5}$$

Putting $(3-n) = m$ and calling $(3-n)k_1$, $k$ we have as above,

$$p_1^{\,m} - p_2^{\,m} = k\,\frac{V^2\, l}{d^5}$$

mission. In regard to the value of the coefficient $k$ we may apply the formula to the results of experiments and see what value of the constant will bring the formula into agreement with the facts.

The best known experiments on this subject are those carried out at the Mont Cenis Tunnel, whose results were given by Mr. Halsey in an article published in the issue of August 27, 1896, and those at the St. Gothard Tunnel, the data of which are given in Mr. Kent's "Pocket Book."

The Mont Cenis experiments indicate a coefficient .000677 for all sizes of pipe, and with this substituted for $k$ in the formula it fits the observed facts very satisfactorily. The St. Gothard experiments indicate a coefficient of .00058 for the 5.91-inch and .00046 for the 7.87-inch pipe. Taken by themselves, the Mont Cenis experiments are much more complete, and yield to analysis more satisfactorily; but in view of the results of an analysis by Mr. A. J. Martin of experiments by Professor Unwin, published in "Engineering" for March 19, 1897, which agree with the St. Gothard experiments in showing a smaller value of $k$ than that given by the Mont Cenis experiments, it seems best to reduce that figure somewhat.

As an average, then, and in consideration of the great variations in the surface of the bore of pipes, which take place according to the kind of pipe used, etc., and which undoubtedly account for the difference in the results of the St. Gothard and Mont Cenis experiments, it is probably safe to say that $k = .0006$ will give fairly reliable results under average conditions; and in future calculations in this article this value is to be understood.

In most cases arising in practice the initial pressure and loss of pressure are given or assumed, together with the volume of air and the length of the pipe; the diameter of the pipe being the dimension which it is necessary to find. Of the accompanying diagrams, Fig. 1 is intended to facilitate the finding of the value of $p_1^2 - p_2^2$ of the equation.

$$p_1^2 - p_2^2 = \frac{.0006\ V^2\ l}{d^5}$$

In this diagram vertical distances represent absolute pressures according to the scale given; the horizontal distance at any point on any curve represents the value of the square of the pressure at that point.

There are three curves and three rows of figures along the bottom, which correspond each to each. The curves all give the same results as far as they cover the same pressures; but the readings become difficult and inaccurate on the steep part of each curve, while the next one below in each case, being on a ten-times more open scale of horizontal distances, is perfectly reliable at the same pressures.

Given the initial and final pressures, their squares may readily be found from these curves, and the difference of these squares will be the value of $\frac{.0006\ V^2\ l}{d^5}$, which for convenience and brevity we may call $R$. If the value of $R$ and one of the pressures be given, the other pressure may obviously be found by the inverse process. Examples will be given later in connection with the explanation of the second diagram, Fig. 2.

For problems in ventilation, heating, blowing cupolas, and the like, the lower curve is the best.

To still further reduce the labor of solving problems of this class, a diagram, Fig. 2, is added, giving the value of $\frac{.0006\ V^2\ l}{d^5}$ or $R$, for all ordinary conditions. This diagram is hardly so simple as the other, but will, it is hoped, be perfectly clear and convenient to use after a few minutes' study.

Three rows of figures will be seen along the bottom, and also along the left-hand edge of the diagram. The latter are the volumes of free air per minute transmitted, and at corresponding points the volume shown by the middle row of figures is ten times that of the inside row, and the outside row ten times that again, or one hundred times that of the inner row.

The vertical distances to the heavy lines corresponding to these rows of figures represent the quantity $.0006\ V^2$, and similarly the numbers along the bottom represent the diameters of pipe in inches; the horizontal distances out to the vertical lines through these numbers representing the value of the fifth powers of these diameters.

The scales for the different rows of figures are so chosen that the ratio of $\frac{.0006\ V^2}{d^5}$ is the same for the sizes of pipe and quantities of free air in corresponding rows of figures.

Now this ratio $\frac{.0006\ V^2}{d^5}$ may be considered as the slope of a line and in horizontal length $l$ the vertical rise of a line at this slope will be $\frac{.0006\ V^2\ l}{d^5} = R$. The figures along the top of the diagram give the values of $l$ in feet up to 1,000, and the figures at the right give the values of $R$ up to 1,500. We have, then, for using the diagram the following simple rule:

Follow the vertical line through the given diameter to its intersection with the horizontal line through the given volume read on the corresponding scale. Follow the radial line from the origin through this point to the vertical through the given length. Follow the horizontal through this point of intersection to the right-hand end of the diagram, and read off the value of $R$ on that scale.

The scales have been so chosen that for by far the greater part of all working conditions, the given volume of free air and diameter of pipe will fall on the corresponding scales; but for very high values of $R$ it may be necessary to take $V$ the volume of free air required on the scale outside of that corresponding to the given value of $d$, and in this case the value of $R$ obtained must be multiplied by 100. $R$ being directly proportional to $l$, if the diagram does not extend far enough to give the value of $l$ on the slope-line required, obtain the value of $R$ for any fraction of the required length, as a tenth, and multiply it by the reciprocal of the fraction. To obtain the size of pipe required for given conditions, obtain the value of $R$ from the first diagram, then, proceeding to Fig. 2, follow the horizontal through this value to its intersection with the vertical through the given length, and follow the slope-line through this point to its intersection with the horizontal through the given volume; follow down the vertical through this point to the row of diameters corresponding to the row of volumes in which the given volume was found, and take the nearest diameter. One or two examples will illustrate sufficiently:

Required the value of R for 1,000 cubic feet of free air flowing through 1,000 feet of 4-inch pipe per minute. Follow up the vertical solid line through diameter 4 inches to its intersection with the horizontal through 1,000 cubic feet, which is found in the middle row of figures, as is also the diameter 4 inches. These intersect at the point $a$. Follow the slope-line through this point to the vertical through the length 1,000 (in this case the end line of the diagram) and read off $R = 600$.

If the initial pressure were 80 pounds (gage) the final pressure may be found thus: Knowing that $R = 600$, we have:

$$p_1^2 - p_2^2 = 600,$$

or

$$p_2^2 = p_1^2 - 600.$$

The value of $p_1$ being $80 + 15 = 95$, we refer to Fig. 1, and find $p_1^2 = 9{,}000$; therefore:

$$p_2^2 = 9{,}000 - 600,$$
$$= 8{,}400;$$

and again referring to Fig. 2, we find $p_2 = 92$ pounds. In other words, the loss of pressure is 3 pounds.

Required the size of pipe to transmit 10,000 cubic feet of free air compressed to 100 pounds by gage, per minute through a distance of 6,000 feet with a loss of 10 pounds pressure. The initial absolute pressure $p_1$ is here 115, and the final pressure $p_2$ is 105. From Fig. 1 we find $p_1^2 = 13{,}200$ and $p_2^2 = 11{,}000$. Taking the difference gives:

$$p_1^2 - p_2^2 = 13{,}200 - 11{,}000,$$
$$= 2{,}200,$$

the value of $R$ for this case, which is greater than the value to which the diagram Fig. 2 reads, as is also the length; dividing both by ten, which obviously we may do, we have the equivalent $R = 220$ and $l = 600$. The intersections of the lines through these are at point $b$; follow the slope line through this point to its intersection with the horizontal through $V = 10{,}000$ on the outer row of figures at the point $c$. Follow the vertical

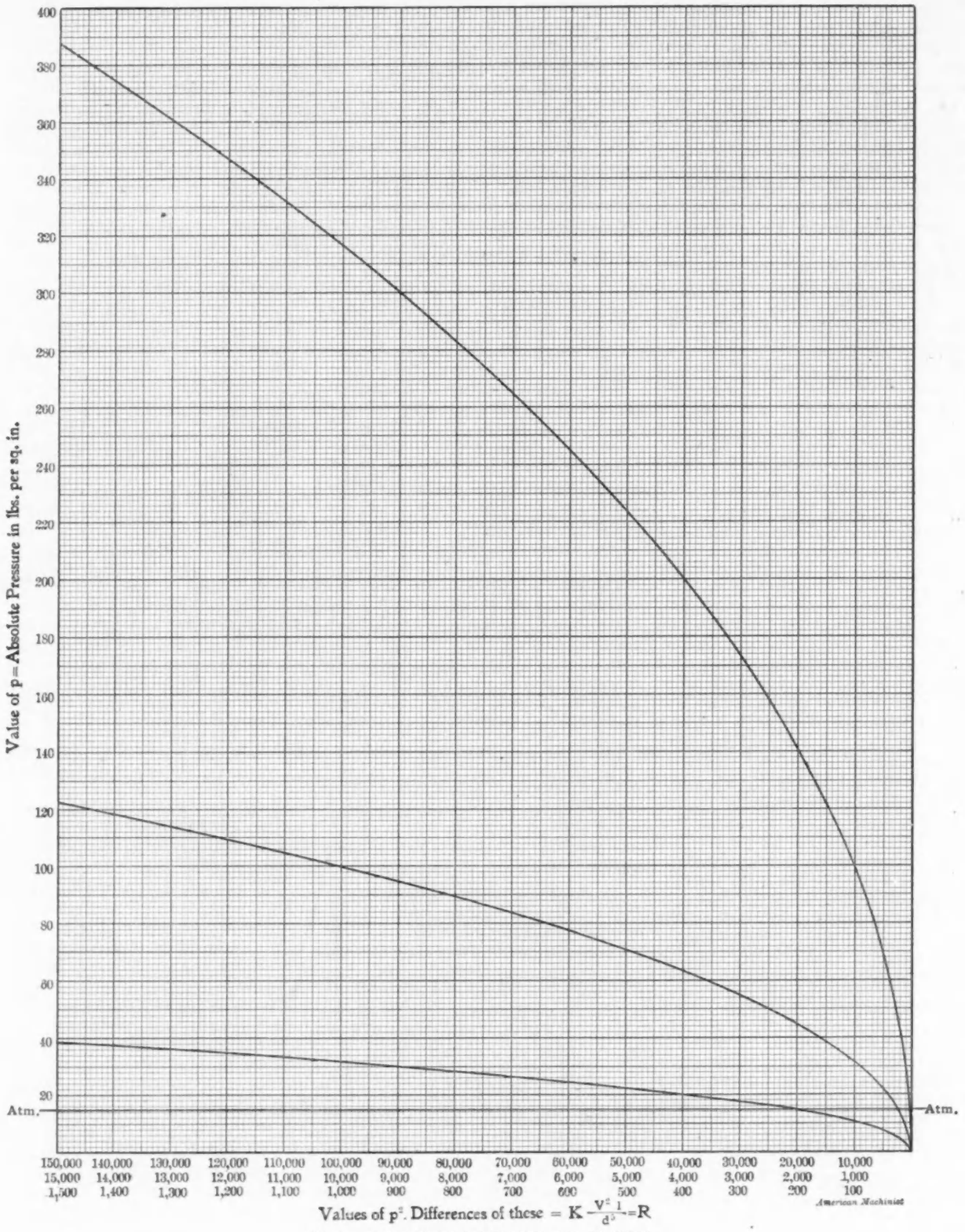


FIG. I. FRICTION OF COMPRESSED AIR IN PIPES.

through this to the outer row of diameters and we find 11 inches nearly.

The lines of this diagram are too crowded in the lower left-hand corner for complete satisfaction in using it, and since this portion relates to sizes of pipe which are in frequent use, a supplementary diagram, Fig. 3, has been added, which is a simple reproduction of this crowded portion of Fig. 2, drawn to a larger scale. The method of using Fig. 3 is precisely the same as of Fig. 2, and no further description of it is needed.

For greater ease of following the lines the verticals through the inner or upper row of diameters are dotted, those through the middle row solid, and those through the outer or lower row broken and dotted; for the same reason the slope lines are drawn alternately solid and broken. It is believed that with a little practice almost any problem in compressed air transmission can be solved by the aid of these two diagrams in a very

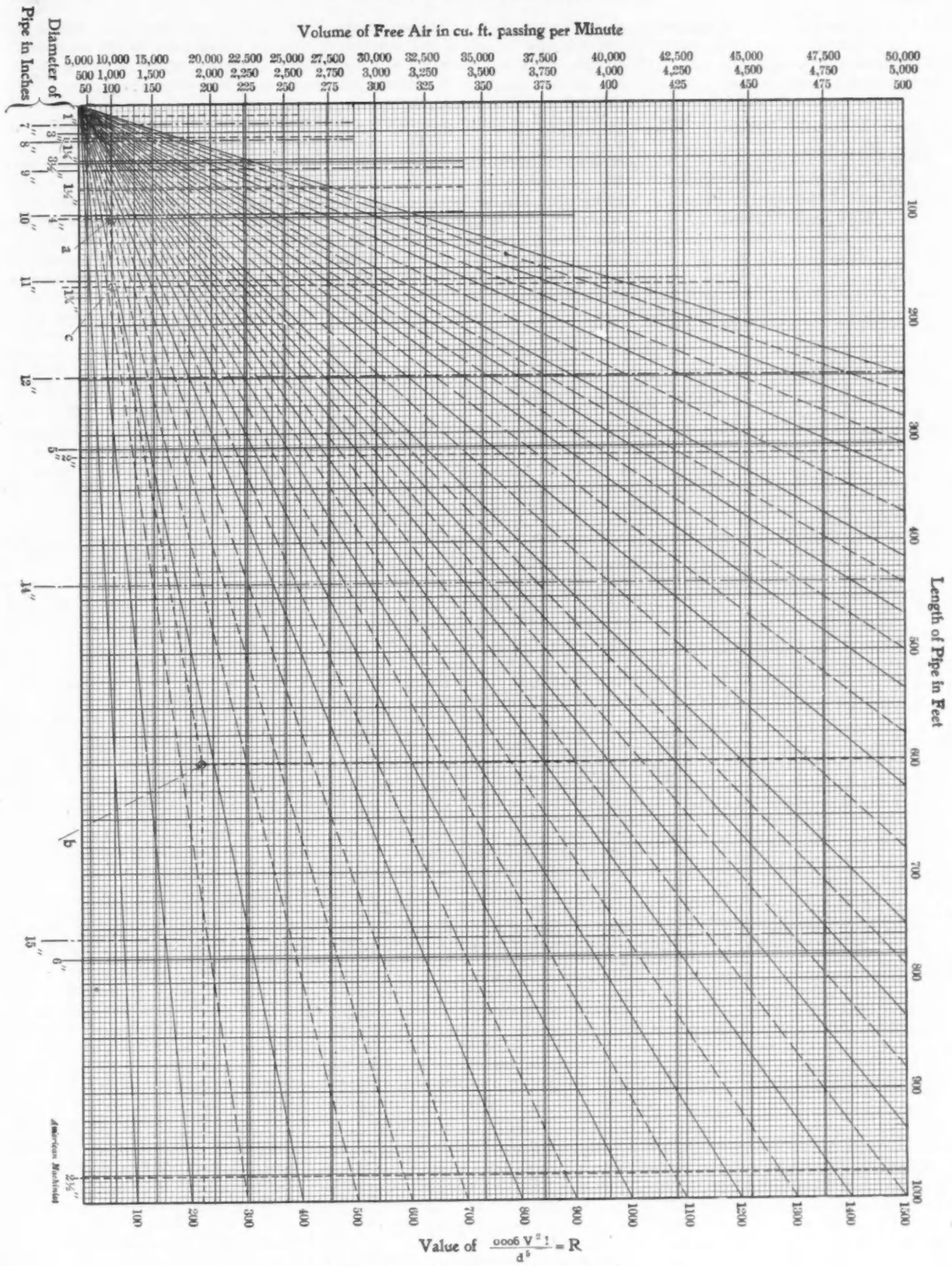
Volume of Free Air in cu. ft. passing per Minute
Diameter of Pipe in Inches
Length of Pipe in Feet
Value of $\frac{.0006\ V^2\ l}{d^5} = R$
American Machinist

FIG. 2. FRICTION OF COMPRESSED AIR IN PIPES.

few minutes, and with a minimum of mental effort.

For convenience the formulas for the discharge of free air and the size of pipe necessary in any given case are appended:

$$V = \sqrt{\frac{p_1^2 - p_2^2}{.0006\ l} d^5}$$

$$d = \sqrt[5]{\frac{.0006\ V^2\ l}{p_1^2 - p_2^2}}$$

in which

$V$ = volume of free air per minute in cubic feet.

$p_1$ = absolute initial pressure in pounds per square inch.

$p^1$ = absolute terminal pressure in pounds per square inch.
$d$ = diameter of pipe in inches.
$l$ = length of pipe in feet.

## German Industrial Progress—Why Her Manufacturers Succeed—Future Tariff Difficulties—Paris Exposition—Her Mercantile Marine.

I think it well to call the attention of American manufacturers to the great progress made by Germany in her foreign trade, for the following reasons: First, because some of the methods which her manufacturers have followed are equally applicable to United States exporters, and the methods which have conduced to German success will undoubtedly add to your commerce. I, of course, do not refer to the questionable methods adopted by the second-rate German houses—such as the fraudulent imitators and similar types. Germany is *not* made up of swindlers. Second—Because there are various tariff changes coming about in due course when the existing treaties expire, and it will repay American manufacturers to keep a sharp lookout in this direction. Third—The progress of Germany's mercantile marine, which has had such a direct bearing on the progress of her foreign trade. This latter fact is doubly interesting to your readers at the present time.

Dealing with the facts under the first heading. The prominent characteristic of the Germans in all their industrial and commercial undertakings is their thoroughness. This quality appears in all their departments of trade. Nothing frightens them; no details are too small to be dealt with; they are pre-eminently painstaking. It would seem that their success in manufactures is largely due to the mass of small innovations they have introduced, rather than to great changes. And then, too, they have the faculty of co-operation to a very large extent. This principle permeates the entire nation. For instance, their well-organized export unions are a sample of this co-operation. These unions have done much to further German foreign trade in all parts. This was noted by the English delegation of the British Iron Trade Association when it visited Germany three years ago. The delegates found that one of the principal causes of the success of Germany in outside markets is energy and enterprise shown by the syndicates organized for the purpose of extending foreign business. One of the largest of these associations is the syndicate of engineering workshops and metallurgical establishments founded about six years ago. It has a membership of seventy-three different works and a capital of $125,000. It is organized on such a basis that it only represents a single house in each special branch of the trade, and it makes vigorous efforts to find an outlet for the productions of each separate concern represented. This syndicate has founded permanent exhibitions of the products of its members and commercial *entrepots* at Athens, Constantinople, Salonica, the Piræus, etc., and has agencies at all the principal Eastern and continental cities. The German consuls are called upon to assist the syndicates and export unions in every possible way. A similar syndicate is engaged in working up a business in South and Central America. One of these syndicates increased its sales 200 per cent. in one year! Another form of syndicate that appears to aid the Germans is that which is established to regu-

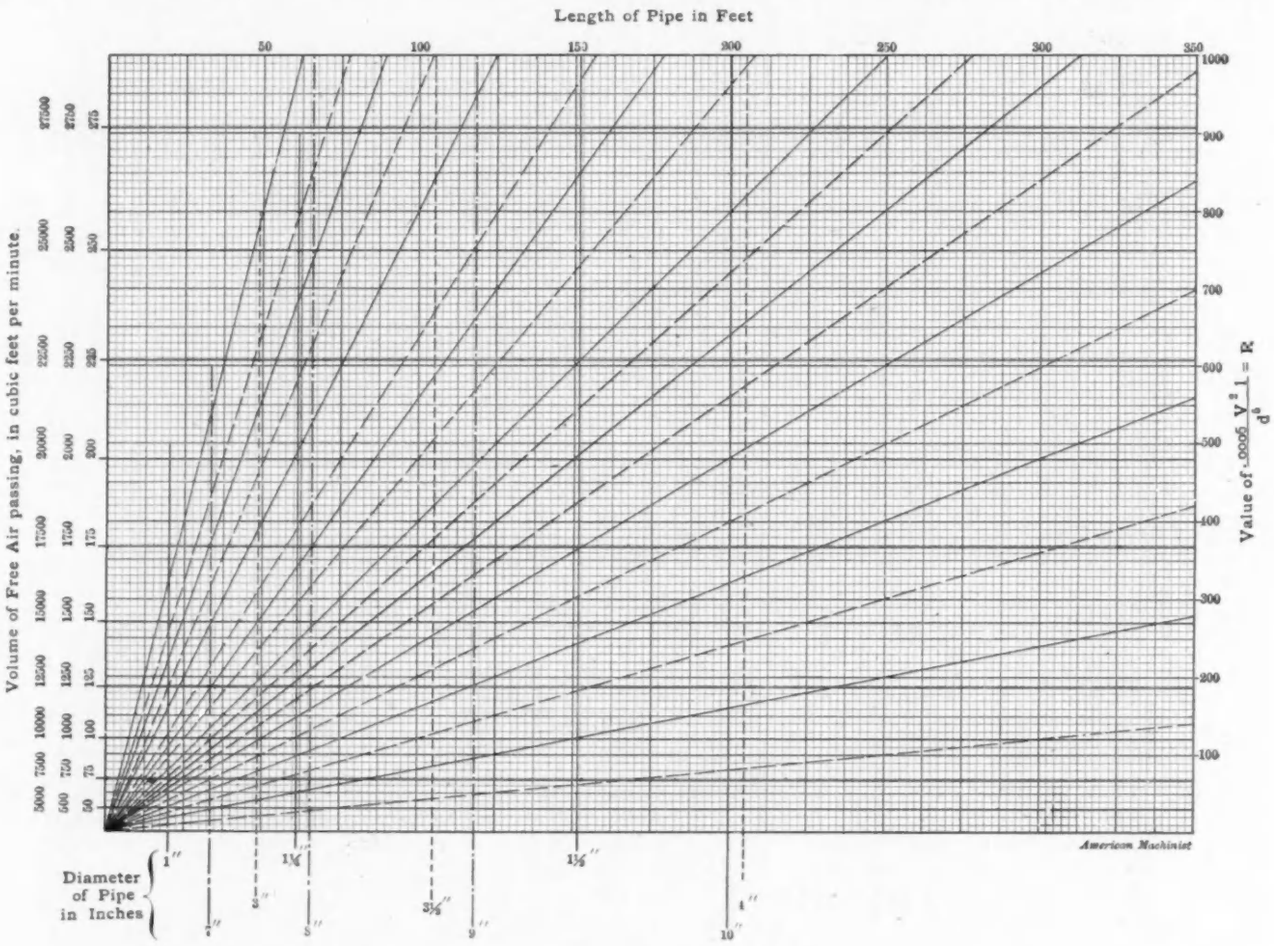


**Fig. 3**

LOWER LEFT-HAND CORNER OF FIG. 2, ON AN ENLARGED SCALE.

late prices and production. One of the most important of these is the syndicate established in the steel industry. These syndicates arrange to supply their best brands to the foreign consumer, in order that they may thereby be the better able to develop their foreign trade. These syndicates do not appear to unduly raise prices, although they do take care to secure higher prices from home than from foreign buyers. The English delegation came to the conclusion that Germany has two sets of prices (so far as the metal trades at least are concerned), one for home consumption and the other for export, and they added, "We have further evidence that, in some cases at any rate, the export trade is carried on at a loss, which is recouped by the better prices obtained for home consumption."

The admitted excellence of the German system of technical and commercial education has of course had an appreciable effect in promoting their foreign trade; but this particular phase of the question requires an article all to itself. Personally, I think that the benefits have been rather over-estimated, and that with all their education the German workman lacks that mental quickness and "braininess" which characterizes the American artisan. There is the danger that the Germans often lack real practical workshop knowledge, although having an abundance of book lore.

As regards the wages paid in Germany, apart from heads of departments and chief officials, there is not the difference in the wages paid as between Germany and England that is generally supposed to exist, taking into consideration the whole of the manufacturing departments in iron and steel works.

The tariff changes referred to in the second section above will probably come about when the existing commercial treaties expire in 1903. The policy of German statesmen begun in 1891, and since maintained, has as its basis the general principle of securing by tariff treaties under foreign markets for German manufactures, while admitting from abroad most raw materials for the home industries free of all duty, and food stuff for the people at reduced customs rates. How best to attain this end is now the main object of Germany's foreign policy. Her future position as a leading mercantile nation will depend very much on the attitude she may be able to assume on the termination of her existing treaties in 1903. The whole strength of the empire is now directed to making its industrial position impregnable. With a view of impressing the world with a sense of Germany's importance, commercially, the Government has already made a grant of $1,250,000 for German exhibits at the Paris Exposition, 1900.

The tendency of German manufacturers has been to clamor against the present tariff arrangements with the United States, which permit American machinery and hardware to be imported into the Empire in competition with the native-made goods. The German manufacturers are, of course, bitterly opposed to the sale of American manufactures in their own country. The agriculturists are also against the importation of American food stuffs; so that it is difficult to see where any reciprocity can come in. The farmers' claims will be fully recognized in 1903, and the Government has pledged itself to promote all interests alike. The farmers will also be protected on military grounds, so as not to make the State dependent on foreign food supplies.

Lastly, with regard to shipping, Germany has, within the last fifteen years, risen from an obscure marine power to a position second only to that of England for steam tonnage. She has done it by subsidizing her steamers and granting "special" railway freights for German materials for shipbuilding. As you are doubtless aware, the railroads are Government properties. The subsidies amount to $1,718,750 a year. The progress of this industry will be seen from the following facts: In 1871 the tonnage of German ships was 982,355; in 1897 it had risen to 1,650,000. The total value of the whole German merchant steamer fleet at the end of 1897 was about $75,000,000. Their mercantile marine is the third largest in the world, and second as regards steam tonnage. German commerce to the East has evidently prospered under the subsidy system, because since the date they were granted the export trade, from 1885 to 1895, doubled in value to China, more than quadrupled to Japan, and trebled to Australia. Curiously enough, the Baltic fleet of the mercantile service has not been so helped, and it has declined in tonnage by 50 per cent. since 1871.

Everything points to the fact that there is at present a capital opening for American manufactures in Germany. American machine tools are always wanted, and there are quite a dozen good houses handling them in the principal cities. In another article I may have something to say as to the exact lines of goods for which there is a demand. I give below, however, a short list which I have specially compiled, and which will throw some light on this question.

EXPORTS OF PRINCIPAL AMERICAN MANUFACTURES TO GERMANY IN 1895 AND 1898.

| | 1894. | 1898. |
|---|---|---|
| Agricultural implements | $536,443 | $1,226,000 |
| Carriages, cars and parts | 79,325 | 109,268 |
| Cycles and parts (1896) | 303,096 | 1,536,593 |
| Scientific instruments (1896) | 223,679 | 299,647 |
| Hardware and tools | 377,559 | 849,257 |
| Sewing machines | 228,126 | 767,173 |
| Typewriters | (statistics not available) | 458,279 |
| Machinery, including steam engines and parts | 514,033 | (not given for 1898) |

The figures for 1898 are partly estimated, but are substantially exact. Only the leading line of manufactures likely to interest the readers of the "American Machinist" have been given. The most significant feature about the table is the steady increase shown wherever a comparison is possible. Thus we see that the United States makers of farm implements have doubled their trade with Germany within the last four years; the trade in cycles and accessories has increased fivefold within three years; the shipments of hardware and mechanics' tools have doubled in value, while the exports of sewing machines have bounded up from $228,126 to $767,173.

F. C. CHAPPELL.

Berlin.

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## The Administration of the Premium Plan—III.

BY F. A. HALSEY.

METHODS OF THE NEWTON MACHINE TOOL WORKS.

The methods of cost keeping in these works are distinctly novel, and this apart from the use of the premium plan. The problem of charging for the tool time as well as for the workman's time in order to cover the difference represented by the widely varying value of machine tools is commonly looked upon as one of the most troublesome connected with cost keeping. In many shops it is not attempted at all, and in others a partial solution of the problem is made by special charges for the extra large tools. In the Newton works a graded series of charges is made to cover all tools in the shop, this charge including the workman's wages. Indeed, the workman's time is taken only for the purpose of the pay roll, the time charged to the work being the tool time. The method by which this is done is, moreover, so simple as to lead to "that tired feeling" when contemplating by comparison some of the schemes that have been proposed for the same purpose.

A small board, like a drawing board, shown in Fig. 10, is provided, to the left-hand side of which a list of the workmen's names is attached. The spacing of the list is such as to register with the lining of a daily time sheet which is fastened to the board each morning with thumb tacks. At the top of the board permanent entries are made for regular time, overtime, in, and out, these entries registering with the first four columns of the daily time sheet, as seen in the figure. A small T-square has on its blade a list of the shop symbols of the machines in progress, this list registering with the vertical columns of the time sheet.

The record of promptness is made on this sheet in the "In" column as the workmen enter in the morning, and in case a workman goes out early the record is made in the "Out" column. Late in the afternoon the timekeeper goes about the shop with this board, entering the workmen's time in line opposite their names and in the columns belonging to the jobs on which they have worked. Each line

opposite a workman's name will be seen to be double. The hours to be charged are entered in the lower space, and the number of the shop tool on which he has done the work is entered in the upper space—a simultaneous record being thus made of the man's time and of the tool time.

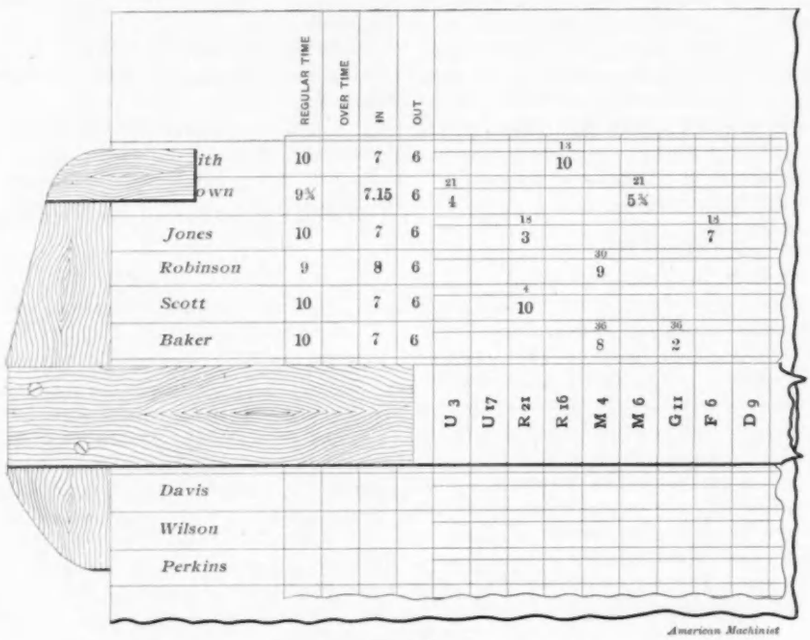


**Fig. 10**

DAILY TIME SHEET, BOARD AND T-SQUARE. ACTUAL SIZE OF SHEET, 11½x18 INCHES.

These sheets are dated and preserved, the key to their meaning being the slips attached to the drawing board and T-square blade, so long as these slips contain the active jobs and the names of the men in the shop. As time goes on, new names are added to the bottom of the vertical slip and new jobs are added to the right of the T-square blade slip—the names of workmen leaving the shop and the symbols of completed work being cancelled by a check mark. When the end of either slip is reached it is removed and a new one is substituted, the old one being dated and filed with the sheets, the record of the date of the change making it possible at any future time to apply the key slips to the sheets, and thus read the original records.

From this sheet the men's time is transferred to the pay roll, and the tool time is transferred to the job time sheet shown in Fig. 11; one of these sheets being in progress for every job being done. This sheet contains in its left-hand column a list of all sizes of tools in the shop. Each charge against a given job is entered in line with the size of the tool on which it was done—work on all tools of a given size being placed against the proper heading. When a given job is done, the sheet contains the record of all time spent upon it, and a classification of that time according to the tools on which it was done. Meanwhile the record of the cost of materials, patterns, drawings, etc., has been made on the large recapitulation sheet shown in Fig. 12. Each charge of this kind is entered in the proper section at the right, the total for each being entered at the left, near the top. The total of the hours for each size of machine tool is entered below, the rates per hour for all tools, and the amounts being carried out in the proper column, of which the total at the bottom gives the final cost of the job.

This series of graded charges per hour is made to cover such incidental expenses as are not covered by specific charges. No account is kept of the premiums in this connection, the charges per hour being such as to include broadly the average premiums earned. This may be criticised, but those who have come to a full realization of the magnitude of other items of cost than wages will criticise it least.

The premium ticket is shown in Figs. 13 and 14, of which the former shows the front and the latter the rear side. These tickets are made up in pads and are alternately blue and yellow. By means of carbon paper the entries for the job, workman, time limit and premium rate, are made on both at once. One is then given to the workman, the other remaining with the foreman for a record. As the jobs are finished, the tickets are turned in to the office, where they accumulate until pay day. The premiums earned by each workman are then added to his regular weekly pay, and are paid out with it. The tickets are then assorted in accordance with the jobs on which they have been earned, and are filed away with the cost sheets.

The three methods of administering the premium plan shown will be seen to have scarcely a single point of agreement, and yet, with the exception of Mr. Newton's treatment of the premiums as an item of cost, they accomplish precisely the same

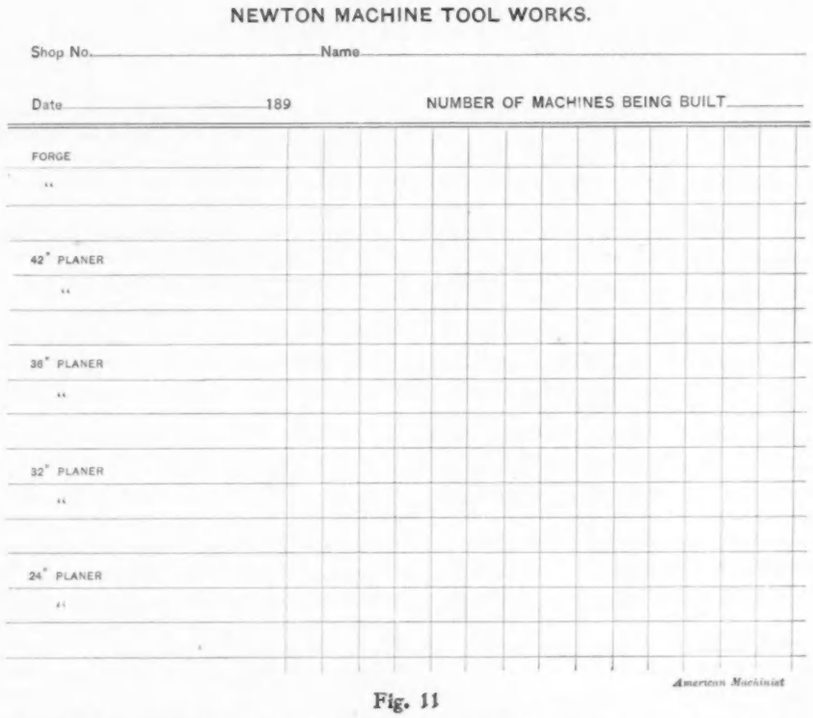


**Fig. 11**

JOB TIME SHEET; ACTUAL SIZE, 11½x18 INCHES; 36 COLUMNS, WITH ONE WIDE COLUMN FOR TOTALS AT THE RIGHT.

NEWTON MACHINE TOOL WORKS.

NAME. SHOP NAME
DATE OF ORDER DATE OF SHIPMENT
NUMBER OF MACHINES BUILT

| | LBS. | @ | PER LB. | |
|---|---|---|---|---|
| CAST IRON | | | | |
| BRASS | | | | |
| FORGINGS MADE OUTSIDE | | | | |
| FORGINGS | | | | |
| WROUGHT IRON | | | | |
| MACHINERY STEEL | | | | |
| MACHINERY STEEL | | | | |
| COLD ROLLED SHAFTING | | | | |
| TOOL STEEL | | | | |
| KEY STEEL | | | | |
| FORGED BOLTS, NUTS, ETC. | | | | |
| STEEL CASTINGS | | | | |
| PULLEYS | | | | |
| | | | | |
| | HRS. | @ | PER HR. | |
| | | | | |
| 42" PLANER | | | | |
| 36" PLANER | | | | |
| 32" PLANER | | | | |
| 24" PLANER | | | | |
| 20" PLANER | | | | |
| | | | | |
| 30" LATHE | | | | |
| 26" LATHE | | | | |
| 24" LATHE | | | | |
| 20" LATHE | | | | |
| 18" LATHE | | | | |
| 16" LATHE | | | | |
| 14" LATHE | | | | |
| 12" LATHE | | | | |
| SLOTTERS | | | | |
| BORING MACHINES | | | | |
| BORING MILLS | | | | |
| BORING MILLS | | | | |
| SHAPERS | | | | |
| CUTTING OFF MACHINES | | | | |
| GEAR CUTTING | | | | |
| MILLING MACHINES | | | | |
| MILLING MACHINES | | | | |
| TOOLS NOT MENTIONED | | | | |
| | | | | |
| ERECTING | | | | |
| LABORERS | | | | |
| PAINTING | | | | |
| SKIDDING OR BOXING | | | | |
| LUMBER USED IN SKIDDING OR BOXING, AND OTHER MATERIAL | | | | |
| SUNDRY BILLS, ETC. | | | | |
| DRAWINGS | | | | |
| PATTERNS MADE OUTSIDE | | | | |
| PATTERNS MADE AT SHOP | | | | |
| REPAIRS MADE ON PATTERNS | | | | |
| TRAVELING EXPENSES | | | | |
| CARTAGE | | | | |
| | | | | |
| | | | | |
| | | | | |
| TOTAL COST OF MACHINE | | | | |
| | | | | |
| | | | | |

NEWTON MACHINE TOOL WORKS.

BUILT FOR
ORDERED BY
ORDER NO. SHOP ORDER NO.

| COLD ROLLED SHAFTING | PRICE | FORGED BOLTS, NUTS, ETC. | PRICE | BOLTS, NUTS, ETC. | PRICE |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| MACHINERY STEEL | | BRASS | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| CAST IRON | | KEY STEEL | | FORGINGS | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | |

**Newton Machine Tool Works.**

**TIME, WAGE and COST CARD.**

No. ..... S. O. .....

Workman, .....

Helper, .....

Work, .....

Parts, .....

| TIME. | HRS. | DATES. | | |
|---|---|---|---|---|
| Began, | | | | |
| Ended, | | | | |
| | | RATES | EARNINGS. | |
| Limit, | | C. | $ | C. |
| Actual, | | | | |
| Premium, | | | | |
| Employees Wages, | | | | |
| Cost per piece, | | | | |
| Inspected, | | | Correct. | |

FOREMAN.

SHOP TOOL No.

*Remarks:*

Read conditions on other side.
Keep daily time on back of this card.
KEEP CLEAN.

Fig. 13

PREMIUM TICKET, FRONT SIDE.

| TIME WORKED. | | | |
|---|---|---|---|
| Date. | Hrs. | Date. | Hrs. |
| | | | |
| | | | |
| | | |

by illustrating the machinery as it stands. The present unsatisfactory internal combustion motors work on a two-stroke cycle. Every student of internal combustion motor construction appears to begin his work with a two-stroke cycle engine, and as there seems to be nothing but four-stroke, or "otto-cycle" internal combustion engines in successful and satisfactory use, the problem of the two-stroke cycle appears to contain unusually difficult points, since such a multitude of experimenters might reasonably be expected to produce at least some plausible approaches to successful action, if such a thing were possible.

The troubles of the two-stroke cycle are, first, the impossibility of clearing the cylinder of burned gases with certainty, and, second, the difficulty of cooling the cylinder when every alternate piston stroke is made effective by a burning charge of explosive mixture. With the four-stroke cycle the cylinder has three-fourths of the total time of action in which the cylinder is subjected to cooling influences, each charge-burning stroke being followed by three strokes in which combustion is absent. In case the two-stroke cycle is used, there is only one-third of the time for cylinder cooling which is available with the four-stroke cycle. Besides this great difficulty with over-heated cylinders, the foul charging due to mixture of burned gases with the fresh charge causes many charges to miss firing altogether, thus wasting fuel and losing power.

The two-stroke cycle, two-cylinder engines now used in this truck are to be replaced by a four-cylinder engine, four-stroke cycle. The cylinder dimensions could not be obtained, but the primary motor is to be nominally of about 12 horse-power.

To provide the very large cooling surface needed to keep the cylinder cooling water from evaporating by reaching a temperature above 212 degrees, return bends of small, thin copper pipe are carried on the sides and front end of the wagon box. This cooling pipe is easily damaged. In the overhauling, heavier water-cooling tubes will be introduced, and they will be placed in a better protected location.

The particulars of this unique truck are as follows:

Wheel gage—66 inches.
Wheel-base—10 feet.
Front wheels—34 inches diameter.
Rear wheels—46 inches diameter.
Tires—4 x 5/8 inch thick.
Total weight—About 8,500 pounds.
Weight of dynamo—About 600 pounds.
Weight of battery—About 1,000 pounds.
Paying load—Up to 5 tons.

As this truck now stands, the engine shaft is lengthwise of the wagon, the cylinders are vertical, and the dynamo is placed at the extreme front, and is reached by a lifting door, hinged under the footboard, as shown in Fig. 2.

In the rebuild, four vertical cylinders, 10 to 12 horse-power, will be placed under the driver's seat, with the shaft crosswise of the wagon; the water-cooling tubes will disappear from the wagon body altogether, and the wheels will be made heavier, and have a much heavier tire and wider face. The present tires are not thick enough to stay on the wheels. The hand wheel and rack and pinion steering action shown will be retained, as it is quite satisfactory.

I saw this wagon in motion, and it handles extremely well. The driver took it out of a very narrow door into the street, and replaced it close to the wall in one corner of the room with ease, the electric motor handling so easily and promptly as to give perfect control.

The spring work is very heavy, as it needs to be to carry a total possible load of 10 tons or more.

The Patton motor system can undoubtedly be made to drive a truck as perfectly as a steam engine can, which is saying much, and the loss of power by transformation need not be so great as to be much more than that due to speed changes effected by gearing. The speeds in the present arangement are four and eight miles per hour, and are regarded as too fast, and will be made three and six miles in the rebuild. The great weight of the "Patton" driven truck is very objectionable, because of the large wheel-load imposed. Until streets are made smooth, it is of the very first importance in motocycle designing to keep weights at the lowest possible figure. It seems possible to design a gasoline-driven truck with a 12 horse-power motor, capable of carrying a paying load of 3 tons, which shall weigh, unloaded, not more than 2 tons, the speed changes to be made by gearing. In this case clutches must be introduced, and so far the clutch is a troublesome feature, being either uncertain or noisy and difficult of manipulation, and not giving anything like the ease and certainty of vehicle handling which are obtained with the electric motor. The heavy automobile is as yet an unsolved problem, and the behavior of the rebuilt Patton truck will be watched with much interest.

HUGH DOLNAR.

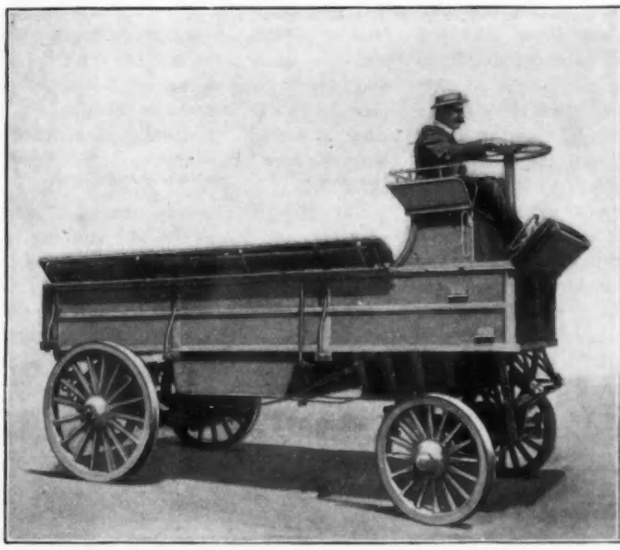

FIG. 1. SIDE VIEW OF HEAVY TRUCK, PATTON SYSTEM.

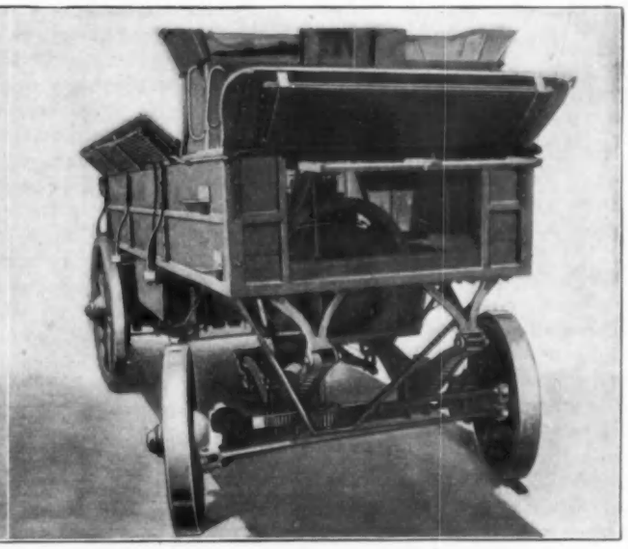

FIG. 2. FRONT OF PATTON TRUCK, WITH DOOR LIFTED TO SHOW MACHINERY.

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The Merchants' Association of New York have arranged for reduced railroad fares during certain periods this summer for the benefit of merchants coming to New York to do business. The rates amount to about one and one-third fares. Full particulars as to dates, etc., may be obtained by addressing the association.

# Letters from Practical Men

## The Certainties and the Uncertainties of Belting.

Editor American Machinist:

Only a week or two ago, when I was talking about the machinist and the molder, I found myself making the remark that the machinist deals with certainties and the molder with uncertainties. I confess that at that moment I was not thinking about the belts that the machinist has to do with. There is considerable uncertainty about them and their performances. There is probably nothing that more requires judgment in the use of rules and formulas and figures than the determination of sizes and speeds of belting for different conditions of service. There are always modifying circumstances which very materially affect the result, but which cannot be worked into the formula. Then, again, there are other things which might be worked in, but which are not. I have been led to try to make a remark or two on this because other fellows have been making remarks. They are always doing it, and they are likely to keep it up; for there is nothing less likely to be fully settled, or, if settled, less likely to be remembered, than the requirements of belting.

It is a very nice thing to figure out the ideal conditions for a belt, the conditions under which a belt will do its best; but it is generally forgotten that in most cases those conditions are absolutely and necessarily unapproachable. There is the speed of a belt, for instance. It is gravely asserted that a belt will do its best, will transmit the most power at the least belt cost, when running at a speed of 5,000 feet per minute. Some use figures a little higher, but that makes no difference. Nothing is said or hinted in the above general statement about the possibility of one of the pulleys over which the belt travels being a very small one, but that would make quite a difference as to the speed at which a belt could properly be run. A belt would run over two 48-inch pulleys very nicely at such a speed; but if one of the pulleys was 48 inches and the other 6 or 8 inches, it could not be satisfactorily run at such speed, or, if it was so run, it could not sustain the same pull and transmit the same power.

Then, again, belts are used not merely to transmit power, but more frequently to change speeds, either up or down. Where the drive is from a main shaft through perhaps two intermediates or countershafts to a fan blower, a small emery wheel, a wood-working machine, or something of that kind, only the last belt of the series can be run anywhere near the ideal speed, the others being so far away from that speed as to be not worth talking about. In speeding down, instead of up, it can only be possible to run the first belt as fast as economy calls for; the others must necessarily run slower. The ideal speed, if attained at either end of the series, could only be used all through by changes of pulley sizes that would be equivalent to the use of a single belt from the prime mover to the last driven pulley. Say that we have a line shaft running 150 turns a minute, and that we want to run a certain spindle at 3,000. If we don't want too great a difference between the diameters of the drivers and the driven pulleys (and it is well to avoid it), we may use two intermediate shafts with the pulleys like this: A 60-inch pulley on the first shaft driving a 30-inch on the second, then a 36-inch pulley driving a 12-inch, and a 20-inch driving a 6-inch on the spindle. Here there would be three belts, the last, if none of them slipped, having a speed of 4,700 feet per minute, the next 2,820 feet, and the first one 2,350 feet. To have the same lineal speed for the first belt as for the last, the first pulley would have to be 120 inches diameter, and the pulleys on the intermediate shafts might be of any size convenient, so that both the pulleys on each shaft were of the same diameter, or the belt might go direct from the 120-inch pulley to the 6-inch pulley. It is quite possible, in arranging the drive for a big factory, to get pretty near the "correct" speed for the engine belt; but if the factory is a machine shop, using hundreds of belts, probably not one quarter of those belts will have, or can conveniently have, more than one-quarter of the "correct" speed that the book-makers call for.

Next to the lineal speed of belting, the other thing is the belt area, or the surface traversed per minute to transmit a horsepower. Six hundred feet per minute of 1-inch belt, or 50 square feet of belt surface per minute, will transmit a horsepower, under good conditions. These figures also are larger or smaller according to taste; but that, again, makes no difference. The rule calls for good conditions, and the conditions are more important and have more effect than the figures. The conditions which are not good are excessively high lineal speeds, very small pulleys, especially in connection with belts that are hard and thick, and ineffective surfaces of either the belt or the pulley, or of both.

It is a rather curious experience that a belt almost invariably has to go through. The average belt-maker does not seem to have been informed as to what a belt is for. He just splices strips of leather together, usually made of good hides and well tanned, until he has the required length. His only lookout is to have the belt of uniform width and thickness. The most important thing of all, the condition of the driving surface, he ignores entirely. Well, the belt, just as it comes from the maker, hard and dry, is put on to drive a certain machine. The pulleys and speeds are all right according to the figures, and so is the belt. All that is needed is the "conditions," and they are not there. The machine is started up, and of course there is trouble. The belt slips, and perhaps runs off, and then there is a course of apologizing for the belt because it is new. We don't apologize for the connecting-rod or the gears because they are new, but we always do for the belts. Then the belt is tightened and tightened, "to get the stretch out of it," as the saying is, until a fellow's mechanical conscience won't allow him to tighten it any more. Still, most likely the belt refuses to drive, and then as a last desperate resort, and as the only remaining expedient, the right thing is done. Some kind of stuff is found that will soften and fill the belt surface and get it so that the whole of it will come in contact with the pulley surface, and then there is no more trouble. After a proper driving surface is secured on a belt, by some such performance as this, it usually maintains an effective surface by picking up and incorporating dust and oil. If it picks up dry dust only, it may begin to kick again, but after the man in charge has once "caught on" to what is needed, he usually does not wait long before he applies the remedy again.

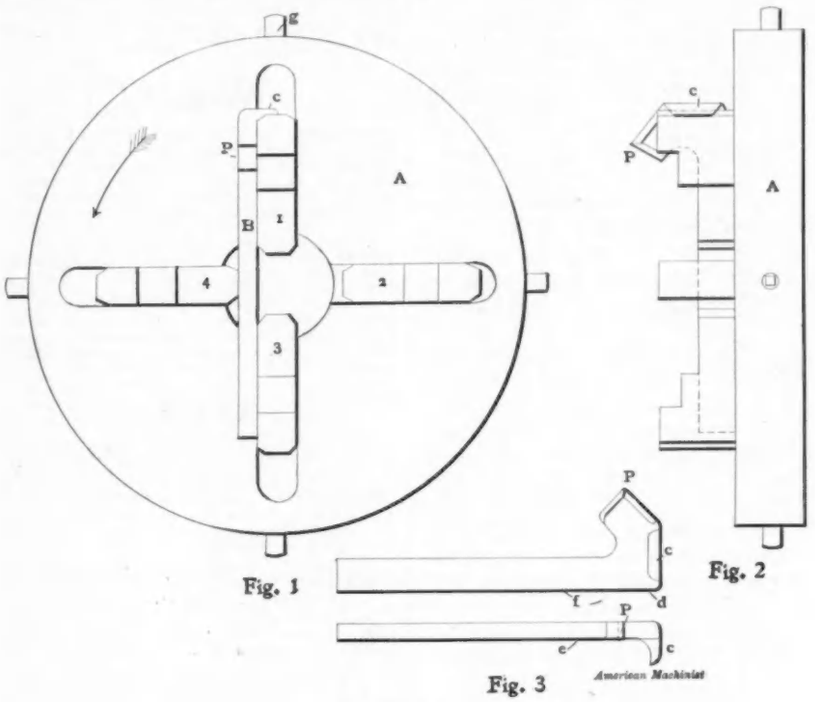
Though the remedy usually proves effective, and leaves the belt running in a state of mild satisfaction, it is, after all, only half a remedy, because it treats only one of the two surfaces. The pulley surface, as it usually comes from the factory, is not such a surface as one with a mechanical turn of mind would be apt to think of as the best in the world for adhesive friction. A smooth, bright surface of iron suggests slipping rather than sticking. And, as a matter of fact, such a surface is very far from being the best kind of a surface for a belt to pull to. We most of us know this from experience. We get all the help that we can from belt-dressing, but then we often find that we need also a pulley dressing; but the trouble is that there is nothing of that kind that can be effectively applied to a running pulley. When we take and cover the bright iron surface with leather, or when paper is cemented to the surface, we find that the belt drives very much stronger than when pulling on the bare iron. The suggestion, then, is inevitable: Why are not the best driving surfaces for both belts and pulleys prepared and secured for them when they are first put in use, instead of resorting to these things as forlorn hopes after a weary course of vexation and delay? Of course there is in all this no suggestion that it is not an excellent thing to have a very liberal allowance of belt and pulley surface, so that it may never be necessary to find out by tedious experiment the limits of belt tension and adhesion.

TECUMSEH SWIFT.

## A Facing Tool.

Editor American Machinist:

I enclose a sketch of a tool that, for the work for which it was made, is about the simplest that I ever saw. It was used in our machine shop to face the flange of a 16-inch cylinder which had been bored with a boring bar in the usual way. The cylinder only required to be faced on one end. The tool is forged as shown in Fig. 3. The steel (⅝x1¼ inches in this case) is bent back on itself, so as to throw the point *P* back of the heel *d*. The hight of P should be a little more than that of the chuck jaw, as seen in Fig. 2. The toe *c* is drawn out and bent over as shown, so as to bear on the end of the chuck jaw, Figs. 1 and 2. The bottom *f* and the side *e*, Fig. 3, should be straight, and also square with each other.




A FACING TOOL.

To use the tool, remove the boring bar and screw the four-jaw independent chuck on the spindle. Place the tool *B* against the face of the chuck, and also against the jaws 1 and 3, and clamp with jaw 4, Fig. 1. Do not clamp so tightly that the tool cannot slide. Begin at the inside of the flange and feed out by using the chuck wrench on screw *g* every time it comes around. A star feed could be easily applied, if enough work was to be done to warrant it. Of course, the toe *c* could be on the other end of the tool, and then feed from the outside toward the center if desired.

If the tool seats well on the face of the chuck and bears well on the side of the chuck-jaw, it will be found a very efficient tool, which requires the least fuss to use of anything I have seen for occasional jobs.

J. H. GILL,
Instructor in Machine and Tool Construction, University of Minnesota, Minneapolis.

## A Forming-Tool Holder.

Editor American Machinist:

Anyone who has tried to hold heavy circular forming tools in place by the usual means employed, viz., a flat-headed bolt through the former and holder, with a nut on the opposite end, will, I am sure, appreciate the simple device here shown, which will hold any circular former precisely in the position in which it is set.

In the old way the holding power depends upon the friction of the head of the bolt; and no matter how hard the nut is tightened, even if a piece of gas pipe is used on the wrench, the former will slip at times, much to the annoyance of the operator, besides decreasing the output of the machine by the delays necessary for the readjustment.

Various means have been employed to overcome this difficulty, most of them too complicated and expensive to be practical. In endeavoring to find something to do away with this annoyance, I hit upon the idea here shown. So far it has proved a great success. The lock is positive, the adjustment simple and quickly made. Very little force is necessary to tighten the nut to hold the former against the heaviest cut.

Fig. 1 shows the method of holding the former if a new holder is made. A square thread is cut in the former as it leaves an arbor for turning, milling, etc., without injuring the thread. A five or six-pitch thread is used, right or left hand, depending upon which side of the machine the former is set; the direction of the thread being such that the former will tighten by the force of the cut.

To get any adjustment, the thread inside the holder must be of a finer pitch than that in the former, and run in the same direction.

If desired to use the old holder, the bolt is made as in Fig. 2; the result is just as good. When once the square threaded taps are made, the work upon the forming cutter is but little more than when making them the old way, while the result is a hundred times more satisfactory.

S. B.

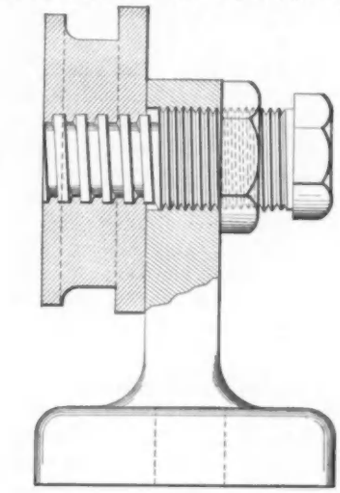


Fig. 1

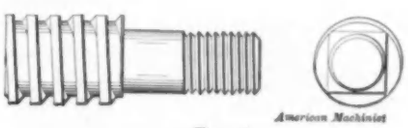



Fig. 2

A FORMING-TOOL HOLDER.

## Railway Facts and Figures.

The voluminous report of the Interstate Commerce Commission upon the railways of the United States, for the year ending June 30, 1898, contains a vast amount of interesting and valuable information, from which we extract a few of the most prominent figures. The total single-track mileage in the United States was 186,396 miles, the length including all tracks being 247,532 miles. There were 36,234 locomotives, 9,956 passenger, 20,627 freight, 5,234 switching, and a few others. The total number of cars was 1,326,174, of which 33,595 were passenger, 1,248,826 freight and 43,753 for the service of the railways themselves. The roads used 20 locomotives and 718 cars per 100 miles of line.

The number of employees was 874,558, or 474 per 100 miles of line. Of these there were 37,939 enginemen, 38,925 fire-

men, 27,876 conductors 66,968 trainmen and 47,124 switchmen, flagmen and watchmen. Eighteen per 100 miles of line were required for general administration, 142 for maintenance of way and structures, 93 for maintenance of equipment, 216 for conducting transportation, and a few unclassified. The aggregate wages paid for the year to more than 99 per cent. of the employees was $495,055,618. This amount represents 60.52 per cent. of the total operating expenses, or 39.69 per cent. of the total gross earnings.

The aggregate number of passengers carried for the year was 501,066,681. The number of passenger-miles was 13,379,930,004. The number of tons of freight carried was 879,006,307, and the ton-miles of freight were 114,077,576,305. The gross earnings for the year, for an operated mileage of 184,648 miles, was $1,247,325,621. The operating expenses were $817,973,276, of which $173,314,958 was for maintenance of way and structures, $142,624,862 for maintenance of equipment, $464,674,276 for conducting transportation, and $36,476,686 for general expenses. The net earnings were $429,352,345, of which only $140,319,421 was available for dividends, and the total of dividends paid was $96,240,864.

The total number of railway accidents of all kinds to persons, reported for the year, was 47,741, the number of killed being 6,859, and the number of injured 40,882. Of employees 1,958 were killed and 31,761 were injured. The number of passengers killed was 221 and the number injured 2,945. Of persons classed as trespassers 4,063 were killed and 4,749 were injured. One out of 447 employees was killed, and 1 in 28 was injured. One passenger was killed for 2,267,270 carried, and 1 injured for 170,141 carried. One passenger was killed for 60,542,670 passenger-miles, and one was injured for 4,543,270 passenger-miles.

## A Useless Rush.

"Engineering," of London, is publishing an account of the Atbara bridge and its construction, and in its issue of June 30 concludes the article as follows:

"Since the foregoing was written we have received information of an interesting incident in connection with the Atbara Bridge. On April 26 there was received at Pencoyd a telegram from the Egyptian War Department, stating that the top chord of one panel of the bridge, as illustrated by the annexed sketch (Figs. 48 and 49), had been lost in transhipment, and must be replaced without delay. This telegram was received at 4 P. M., when a duplicate of the missing part was at once set in hand; it was completed, packed, and on its way to New York the following morning at 9 A. M. The duplicated part arrived duly in Liverpool, where it remained awaiting further instructions for at least three weeks."

## The Liquid Air Delusion in England

At Taunton last week the electric lighting committee presented a report from the consulting engineers, advising certain further improvements and extensions in connection with the electric supply works, and asked the Council for sanction to obtain tenders for the plant required. The chief opposition to the adoption of the committee's recommendations was a certain Mr. Standfast, who read an extract from "Tit Bits," stating that "liquid air would supersede boilers and engines, and that coal, wood and water would be required no longer. Factories would be worked by liquid air, which would be drawn from a source that was inexhaustible." From this he argued there was a possibility of the new boilers and condensers not being required for the Taunton electricity works, and it was well to pause before laying out money on them. "It is a pity," he said, "that men's minds are so shallow. . . ." It is.—"The Electrician," London.

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In view of the fact that work in connection with the dredging of New York Harbor is soon to be begun, the following facts regarding dredging operations at Liverpool, England, may be of interest: Just off the port of Liverpool there exists an immense sand bank, familiarly known as the "Bar." Prior to 1890 it was impossible for an ocean steamship to cross this obstruction except at high tide. Ships might make a speedy voyage across the ocean, and yet if they arrived at this bank a short time after high water, it meant that several hours had to be spent outside. This resulted in great loss of time to both passengers and mails. The Mersey Dock and Harbor Board ordered dredges of special construction and set them to work, with the result that whereas in 1890 the

(*Continued on page 39.*)

# Miscellaneous Wants.

*Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.*

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer. Mach. T. Co., Meriden, Ct.

Punches & dies. Wal. M. Wks., Waltham, Mass.

Light and fine mach'y to order; models and elec. work specialty. E. G. Chase, Newark, N. J.

Book "Dies and Diemaking," price $1, post paid. J. L. Lucas, Prov., R. I. Send for index sheet.

Wanted—A second-hand pulley lathe, from 6 to 18 inches. Address De Loach Mill Mfg. Co., Atlanta, Ga.

Selden Packing for Stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., New York.

For Sale, Cheap—Second-hand 10 in. Gould & Eberhardt shaper. Wheeler Condenser & Engineering Co., 120 Liberty st., New York City.

Threads and gears; easy rules to cut any thread possible to be cut in the lathe, without algebra, sent to any address for 25c. by G. W. Dixon, Spring Lake, Mich.

Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

Wanted—By an English engineering magazine, smart, original articles on workshop practice, machine tools, etc. Address Box 138, AMERICAN MACHINIST.

Gear and milling cutters, adjustable reamers and special tools; vertical millers, cutter and surface grinder and shears. Catalog of small tools free. R. M. Clough, Tolland, Conn.

Have a first-class agricultural machine, just patented, partly introduced, with good success and prospect, and have in view a very suitable for sale machine works; capital wanted to push same. J. M. K., Box 6, Maria Stein, O.

In order to still further develop an established business in machine-tool attachments and specialties of unusual merit, man with $5,000 and some acquaintance with machine-tool trade will be admitted into company. Address Box 126, AMERICAN MACHINIST.

Institutions retiring from business having machine tools, brass or wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Partner Wanted—An all-round machinist, to take half interest in old-established machine shops; valuable plant; strictly cash business done; $5,000 needed; proprietor, ill-health, retiring; excellent opportunity to right man; full particulars. Address "Canadian," AMERICAN MACHINIST.

# Wants.

*Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.*

## Situations Wanted.

Draftsman, mechanical, for New York, wants position. Box 145, AMER. MACHINIST.

Mechanical engineer and draftsman is open for engagement. Box 139, AMER. MACHINIST.

Blacksmith, first-class tool-dresser, desires a change; will go anywhere. Box 127, AMERICAN MACHINIST.

Position, by young mechanical draftsman, with 5 years' shop experience. Address Box 140, AMERICAN MACHINIST.

Draftsman, recent university experience, also 7 years' pattern-shop experience, wants position. Address Box 137, AM. MACHINIST.

Wanted—Position as foreman; experienced on experimental and special machinery; good references. Box 146, AMERICAN MACHINIST.

Position as brass foundry foreman, by an up-to-date hustler; 20 years' experience, 8 as foreman. Address Box 122, AMERICAN MACHINIST.

Experienced mechanical engineer, speaking French fluently and German fairly, desires position with machinery exporter. Box 136, AMERICAN MACHINIST.

American of some experience on the road, practical machinist, hard worker, good habits, wants position as traveling salesman. Box 147, AMERICAN MACHINIST.

Wanted—A position as assistant layer-out, boiler maker or sheet-iron worker, by a steady, sober man; repair shop preferred. "Reliable," AMERICAN MACHINIST.

Experienced foundry foreman on loam, green sand and dry, wants position; engine or special work; N. E. or N. Y. shop preferred. Box 125, AMERICAN MACHINIST.

Situation, by a practical man with 20 years' experience drafting, experimental work and manufacturing; understands modern methods and cost-cutting. Box 141, AMER. MACH.

Position as assistant superintendent, or with consulting mechanical or mill engineer, by graduate of Stevens Institute with 4 years' experience. Box 148, AMERICAN MACHINIST.

Situation wanted as superintendent or head draftsman by mechanical engineer; 15 years' experience; specialty, development and duplication of light intricate mechanisms; advanced methods; can handle large business. Box 142, AMERICAN MACHINIST.

Position wanted by a mechanical expert, experienced in machine-shop and drawing-room practice; has been especially successful

in developing inventors' ideas, and designing automatic machinery; New York or Brooklyn only. Address Box 128, AMER. MACH.

A practical mechanic with 11 years' experience in shop and drawing room and 5 years in business office, believes he could be of value as superintendent or assistant manager of a good machine business; can handle advertising, systematize office and handle men. Box 92, AMERICAN MACHINIST.

An experienced, middle-aged mechanical engineer, recently returned from Europe, seeks position of master mechanic or works manager; large and varied practice in machinery and up-to-date shop methods; expert draftsman; good executive and business ability and correspondent; excellent testimonials. Address Box 144, AMERICAN MACHINIST.

A practical, inventive, up-to-date mechanical superintendent, with 16 years' experience on sewing machine, typewriter, bicycle and all kinds of light manufacturing, desires a change; Eastern man; thorough, systematic; age 32; American; A1 references; small town in N. Y., Pa. or Ohio preferred. Address Box 143, AMERICAN MACHINIST.

## Help Wanted.

Gas engine factory wants foreman in machine shop. Address Western Tool Co., Jefferson, Ia.

Pattern-makers wanted at once. Apply to the Fishkill Landing Machine Co., Fishkill-on-the-Hudson, N. Y.

Wanted—Good, all-round machinists; state age, experience and wages wanted. Beall Machine Works, Cumberland, Md.

Wanted—Mechanical draftsmen; men familiar with electrical machines preferred; steady work for good men. Apply 42 Centre st., Lynn, Mass.

Wanted—Salesman to sell tapping attachment and sensitive drill on com.; are good sellers and will make profitable side line. Union Tire Co., Plainfield, N. J.

Wanted—Foreman for machine shop; must be well up in modern methods and machine work; state age, experience, references and salary. Box 131, AMERICAN MACHINIST.

Wanted—Intelligent machinist, used to machine-tool work, as instructor in machine shop of technical school in Middle West. Address, with particulars, Box 134, AM. MACH.

Wanted—Foreman for machine department of large structural iron works, engaged in the manufacture of bridges, buildings and similar works. Address "Rotary," AMERICAN MACHINIST.

Wanted—Technical partner, who controls medium shop, for the manufacture of agricultural machine with an annual market of over 80,000, amply protected by U. S. patents. Address Box 133, AMERICAN MACHINIST.

Wanted—Foreman for machine shop; an up-to-date, wide-awake man able to produce good work at lowest cost, is required. Address, giving references, experience and salary desired, Box 129, AMERICAN MACHINIST.

Wanted—Foreman for machine shop employing 60 hands on all classes of engine work; must be experienced and well up in handling men. Write, stating experience and wages required, to Box 135, AMER. MACH.

Wanted—Tool-maker and machinist, experienced on experimental work, from making drawings to getting ready for manufacture. Address, stating references, age and wages expected, Box 132, AMER. MACHINIST.

Wanted—First-class machinists and toolmakers, including assistant foreman on small fixtures and fine die work. Address, stating complete experience, age, wages expected and references, Veeder Mfg. Co., Hartford, Conn.

We are enlarging our works, and will shortly require an increased number of skilled mechanics; we invite applications from draftsmen, pattern makers, molders and machinists. Address the Westinghouse Machine Company, East Pittsburgh, Pa.

Wanted—Several first-class and experienced mechanical draftsmen who have some ingenuity and are capable of laying out and finishing their work; position permanent; salary according to ability. Address E. H. Dyer & Co., 705 New England Building, Cleveland, O.

Wanted—Chief draftsman and assistant, in Philadelphia; experienced in designing machine tools, hydraulic and general machinery; permanent position and advancement for the right man; state if graduate in engineering, age, experience, references and salary expected. Address Box 130, AMER. MACHINIST.

Wanted—A thoroughly experienced man, capable of taking the superintendency of an agricultural implement factory; must be of good character and habits, a first-class mechanic and organizer, well recommended. Address, giving full information as to above requirements, giving age and stating whether married or single, Lock Box 309, Jackson, Mich.

Wanted—Several first-class machinists, also a number of young men and boys who have had some experience in machine shops, by a concern manufacturing high-grade machinery, located near Chicago; shop is new and strictly up to date; steady work and good opportunities for the right kind of men. Write, stating age, experience, wages expected, to Box 149, AMERICAN MACHINIST.


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**THE UNION TIRE CO.,**
Plainfield, N. J.

(*Continued from page 38.*)

depth of water at low tide was only 11 feet, it is now 27 feet. The amount of sand which had to be removed from the bar itself in order to bring this about has been 22½ million tons, while from the bar and main channel there have been removed 41¼ millions of tons.

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Curtis & Curtis, of Bridgeport, Conn., have developed their hand pipe-cutting and threading machine (which has been illustrated in these columns) so that the larger size, as now made by them, is remarkable for its range and capacity. It will cut off and thread wrought-iron pipe from 2½ inches to 12 inches diameter. This is accomplished by a machine occupying a bench or floor space less than 24 inches square, and one man can thread pipes up to the full capacity of the machine. Pipes can thus be cut and threaded where they are to be used, and if desired the machine can be supplied with a base for using power, so that it may be used either in the shop or outside, as may be called for by circumstances.

---

Professor Mosso has recently given some account, as follows, of the use of compressed air in a tunnel in Italy:

"There is a long tunnel not far from Genoa, through which about 200 trains a day pass. These necessarily leave an immense amount of smoke in the tunnel, and as the air is bad, the coal does not burn well, filling the tunnel with poisonous gases. I was asked what could be done to prevent this.

"We tried two methods. First, we experimented with compressed air, having large cylinders of steel filled with air at the pressure of 50 atmospheres. The cylinders were about 5 feet long and 2 feet broad, made to resist the enormous pressure. These we placed in the tender of the locomotives, and in passing through the tunnel allowed the air to escape. This pure air blew back the smoke and cooled and purified the atmosphere.

"The second method was with compressed pure oxygen. This was allowed to escape from the cylinders into the fires of the engines, causing a complete combustion of the coal, and preventing the formation of dangerous gases, as well as making the air purer by the addition of oxygen.

"They will use the compressed air method, as it is cheaper and almost as good as the oxygen."

---

In our issue of May 26, 1898, we printed a cut of a new form of centrifugal pump and a letter by Mr. H. Hill, a pump manufacturer, of Anderson, Ind., who had seen the model in the hands of an old gentleman there. We have since learned his name and address to be Mr. Jacob Baker, 27 North Ninth street, Richmond, Ind., and thinking it might be of interest to

some of our friends engaged in the manufacture of the old centrifugals, we give it. It will be remembered that his plan avoids friction by running the propeller within an air chamber at the top thereof, above the water, while at the same time obtaining pressure at any speed desired. With it it is claimed that less than one-quarter the power is required as compared with the old or water-submerged form.

---

A serious accident occurred to the British torpedo boat destroyer Bullfinch during her trial on July 21, killing nine men and injuring four others. It is stated that while running at thirty knots an hour a connecting rod first broke and that then a cylinder head was knocked out, the men being mostly killed by scalding. The necessity of making every part as light as possible upon boats of this type leaves but a small margin for safety, and accidents are more frequent than with any other class of vessels. It is greatly to the credit of our engineer corps that so few accidents have occurred during the period of building our "new navy."

---

## Manufacturers.

At Franklin Park, Ill., Forster, Waterbury & Co. will erect a malleable-iron plant, to cost $50,000.

The Milford Manufacturing Company has been organized at Milford, Conn., for the purpose of manufacturing machinery.

Over $100,000 will be expended by the newly incorporated Northern Ohio Traction Company for the erection of a new electric power house in Akron, Ohio.

The steel frame work of the West Bay City (Mich.) sugar factory is going up very rapidly, and this part of the work will be completed before August.

The casting plant at the Addystone Pipe & Steel Foundry, near North Bend, Indiana, was destroyed by fire on the 17th inst. The loss is estimated at $100,000.

The works of the Riter-Conley Manufacturing Company, Preble avenue, Allegheny, Pa., which were partially destroyed by fire recently, will be rebuilt at once.

The Wetherill Separating Company, Newark, N. J., is about to erect, at the corner of Ferguson and Clover streets, a one-story brick extension to its factory, 23x80 feet.

Collom & Anderson are about to rebuild a three-story brick cloth mill, 125 by 35 feet, for J. & J. Dobson, at the northeast corner of Stenton avenue and Godfrey street, Philadelphia, at a cost of $12,000.

The Monongahela Light & Power Company, that now has control of most of the electric lighting, heat and power plants in the Monongahela valley, recently began excavation for an immense power plant at Rankin, Pa.

The Friedberger Manufacturing Company contemplates making over $10,000 worth of improvements at its plant, at Eighteenth street and Fisher's lane. The work will consist of the erection of a three-story addition, 45x45 feet, adding two stories to a one-story building, 63x35 feet.

The General Electric Company has bonded about 30 acres of land at Lynn, Mass., and

(*Continued on page* 41.)


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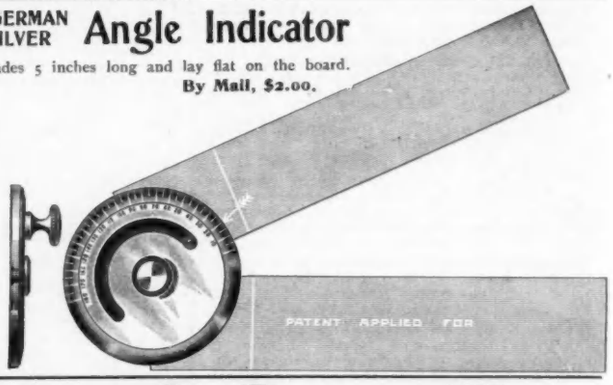


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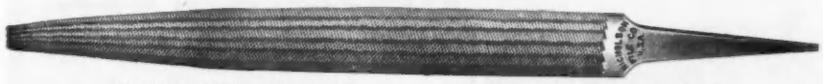

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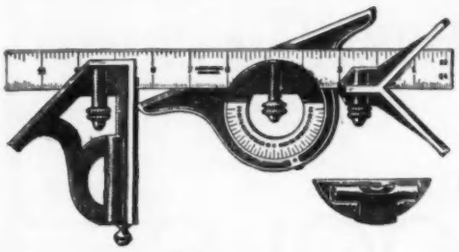

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(*Continued from page* 40.)

a large addition will be made to the present steel plant, so as to nearly double its capacity, and additional buildings will be built to accommodate a portion of the work now done in Schenectady, N. Y.

The A. B. Pitkin Machinery Company, Providence, R. I., announce that they have acquired the records, drawings, patterns and parts, unfinished and finished, of the Armington & Sims engines, and arrangements are now being made which will enable them to supply any parts of these engines.

Architect J. H. Windrim, 1107 Walnut street, has awarded the contract for the power house building at American street and Susquehanna avenue, Philadelphia, Pa., to Contractor Charles McCaul, 10 North Eleventh. The building will be constructed of brick and iron, measuring 55x120 feet, costing, complete, $40,000.

The Westinghouse Company has acquired 100 acres of land close to Manchester, England, and will immediately erect works covering 40 acres, practically duplicating its Pittsburgh plant. The works will be capable of employing 5,000 hands. Lord Kelvin will be electrical adviser of the company. The enterprise is backed by £1,500,000 of British capital.

Plans have been drawn for proposed new shops for the Reading Railway Company, at Reading, Pa. The improvement, it is stated, is to cost $500,000. The main structure of the new plant will be 300 by 700 feet, and there will be a number of smaller buildings. The present locomotive shop will likely be leased to an outside party for manufacturing purposes.

The Electric Light & Power Company, of Syracuse, N. Y., are extending their present power house. The extension will be 70 feet wide and 100 feet long, one-story structure, having brick side walls and steel framework. The steel framework is arranged to carry two traveling cranes over their dynamos and engines. The Berlin Iron Bridge Company, of East Berlin, Conn., have been given the contract to design, furnish and erect the steel work in this extension.

The regents of the Kansas State Agricultural College are now receiving bids for erecting the extension to the machine shops, for which the last legislature appropriated $16,000. The capacity of the shops will be doubled, and the new buildings will include blacksmith shop, foundry, testing laboratory, steam-fitting shop, brass foundry and additional machine shop. The extension will provide room for 300 additional students, and will be ready for use October 1.

Articles of incorporation were filed recently by Messrs. D. M. Drennen, W. M. Drennen and F. W. Hopkins, under the name of the United States Explosive Manufacturing Company, Birmingham, Ala. The capital stock is $200,000 at $100 per share. The new corporation will begin at once the construction of a plant for the manufacture of powder, dynamite and other explosives. Work on the new plant is to be commenced at once, and it is to be completed within six months.

Geo. F. Payne & Co. have applied to the Bureau of Building Inspection for a permit to erect a new factory for the Charles Scott Spring Works, whose plant at Germantown avenue and New Market street, Philadelphia, Pa., was burned out recently. The new building is irregular in shape, and will have a frontage of 185 feet on New Market street, 130 feet on Germantown avenue, 285 feet on Hancock street and 159 feet on the rear end. Wilson Bros. & Co. are the architects. Work will be started as soon as the permit is granted. The cost of construction will be about $56,000.

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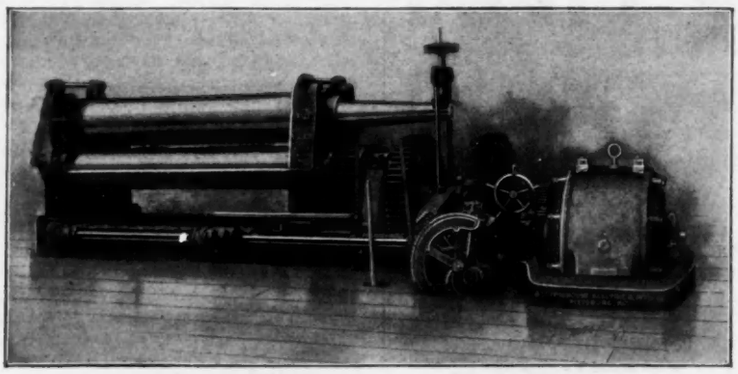

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